



National Capital Region Network 2007 Forest Vegetation Monitoring Report

Natural Resource Report NPS/NCRN/NRTR—2008/125



ON THE COVER

Forest habitat in Catoctin Mountain Park
Photograph by: Thomas Paradis, NPS.

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Executive Summary

This report presents a summary of the forest condition data collected in 2007 by the National Capital Region Network Inventory and Monitoring Program. Forest condition was monitored on 100 forest plots randomly located throughout the National Capital Region. This data is part of a long term forest monitoring effort that will include 400 forest plots. One hundred plots will be monitored each year, and any particular plot will be monitored once every four years. As this is the first time that these plots are monitored only status data but not trend data is available.

In 2007, information was collected in nine of the eleven parks in the network. The data collected includes information on the distribution, abundance and basal area of trees, saplings, shrubs and seedlings and the quantity of coarse woody debris. Data was also collected on threats to the forests, such as insect pests and exotic invasive plant species.

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Introduction

Forests are the predominant natural vegetation in the eleven parks which make up the National Capital Region Network (NCRN, Table 1). Although many of the parks protect cultural and historic resources and provide recreational opportunities, all eleven parks have significant forest resources. In some cases, such as battlefield parks, historic forests are a cultural as well as a natural resource in that they help park visitors understand the events that took place in the park.

In 2005, the Inventory and Monitoring program of the NCRN listed 21 priority “vital signs”, which are indicators of the state of natural resources in the NCRN parks (National Park Service 2005). Forest vegetation is one of these vital signs. The focus of this vital sign is to track changes in community composition, such as species composition, growth rates and mortality rates of forest plants.

Two additional vital signs, invasive plant species and forest insect pests and diseases, examine potential threats to forest vegetation and are included in this report. Invasive plant species can crowd out native vegetation and could lead to changes in community composition. Insect pests and diseases can reduce populations of individual plant species.

To address these vital signs, in 2006 the NCRN began a long term forest vegetation monitoring program. The monitoring program consists of taking measurements of forest vegetation on a series of randomly located plots (Schmit et al. 2006; Schmit and Campbell 2007). The plots are modified versions of those used by the Forest Inventory Analysis program of the US Forest Service (Stolte et al. 2002).

This report summarizes the findings of forest vegetation monitoring at the regional and park levels for 2007. This is the second year of forest monitoring, and is the second year in a four year panel. Methods are the same as those used to monitor plots in 2006, with some exceptions. The diameter at root crown was measured for all shrubs in 2007, as was decided after the 2006 monitoring. Eleven new species were added to the lists of shrubs, two of which are exotic invasives. These species were encountered in 2007 but not 2006.

During 2007, I&M staff revisited plots monitored in 2006 to verify tree identifications. Some incorrect identifications were found, particularly confusing species within the oaks (*Quercus* spp.), elms (*Ulmus* spp.) and hickories (*Carya* spp.). A corrected tree list for the 2006 forest monitoring is included in Appendix D.

As this is the first time this set of plots have monitored, only status data is presented. Although some results, such as the presence of invasive species, are inherently undesirable, no formal assessment of the state of the parks is made in this report. The second round of sampling of the plots will begin in 2010. At that time the NCRN will be able to begin to evaluate trends in forest communities.

All raw data is available in electronic form directly from the NCRN.

Methods

Plot Locations

Forest monitoring plots have been established throughout the eleven parks that make up the NCRN. Plot locations were selected using a randomized design known as “generalized random tessellation stratified” (GRTS; Stevens and Olsen 2004). A GRTS design gives the investigator a spatially balanced (not clumped) and random set of sampling sites. The output of a GRTS draw is an ordered list of potential plot locations. If some of the locations are not suitable they are eliminated and the next locations down the list are chosen instead without the loss of spatial balance or randomness. This is particularly useful in the National Capital Region where current vegetation maps are not available for all parks, and cultural, archeological or other concerns may preclude plot setup on otherwise suitable sites.

In order to choose locations for the forest plots, ArcMap 9.0 was used to place a 250m grid over the entire region. Every intersection of the grid was a potential monitoring location. The 250m spacing was chosen as the NCRN will monitor forest birds at these locations, and bird monitoring points should be 250m apart (Dawson 2006). A GRTS draw was performed on this list of potential locations using S-Draw1b (West Inc 2005). As a result of this methodology the number of plots in each park over the 4 year sampling cycle will be approximately proportional to the forest area in each park. Starting in 2005, potential sampling locations were visited and unsuitable sites were eliminated from forest monitoring. In order to find 100 forest plot locations for 2007, 215 locations were considered, of which 115 locations were rejected. Locations were rejected for a variety of reasons including: being found in managed grasslands, roads or other non-forest habitat; being located off of park-owned property, or due to slopes steeper than 30°. After permits were obtained, plots were established at these locations and later measured by the seasonal monitoring crew (Table 1).

Table 1. Location and number of forest monitoring plots in 2007.

Park name	Park abbreviation	Plots monitored	Locations rejected
Antietam National Battlefield	ANTI	3	11
Catoctin Mountain Park	CATO	17	3
Chesapeake and Ohio Canal National Historical Park	CHOH	16 ¹	52
George Washington Memorial Parkway	GWMP	8 ¹	9
Harpers Ferry National Historical Park	HAFE	2 ²	3
Manassas National Battlefield Park	MANA	6	12
Monocacy National Battlefield	MONO	0	0
National Capital Parks-East	NACE	13	18
Prince William Forest Park	PRWI	33	7
Rock Creek Park	ROCR	2	0
Wolf Trap National Park for the Performing Arts	WOTR	0	0

¹Four plots located in the Great Falls area on the Maryland side of the Potomac Gorge are on land managed by CHOH but owned by GWMP. Results for these plots are reported under CHOH.

²One potential plot in Harpers Ferry is located on land which is not currently owned by the park, but which may be transferred to the park in the near future. If this transfer takes place, this plot will be monitored beginning in 2011, when the Panel 2 plots will next be monitored.

Plot Layout

Each forest monitoring location consists of a 15m radius circular plot with an area of 707 m² (Figure 1). All trees ≥ 10 cm dbh (diameter at breast height, 1.37 m) are identified, the diameter measured at breast height, tagged and mapped in the plot. Trees are marked at breast height with forestry paint so that future measurements will be made at the same location on the tree. Also recorded is the presence of vines on each tree, targeted insect pests and diseases (Appendix A), and other conditions that could increase tree mortality.

Within the main plot are three 3m radius circular microplots, with a combined area of 85m². All saplings (trees between 1 and 10 cm dbh) and shrubs are identified, measured and tagged on these microplots. Saplings are measured at breast height and shrubs are measured at the root crown. Shrubs are woody species that are generally multi-stemmed. In practice, the field crew is provided with a list of species which are to be measured as shrubs (Appendix B).

Three 15m long transects radiate out from the center to the edge of the plot, which are used for measuring coarse woody debris. All woody debris ≥ 7.5 cm diameter and 1 m length is measured and assigned a decay class.

Finally, 12 1m² quadrats (0.5 m x 2 m) are placed in the microplots and along the transects. Cover of select exotic and native herbaceous species (Appendix C) and seeding regeneration is measured in the quadrats.

Forest plot design and measurements are generally based on that of the US Forest Service Forest Inventory and Analysis Program (FIA), but modifications have been made. In general, the total area of the plot is nearly the same as that of the FIA plots (Stolte et al. 2002), but the NCRN

plots are more compact. The more compact design was adopted as it is better suited to monitoring very small forest patches, which are often found in NCR parks.

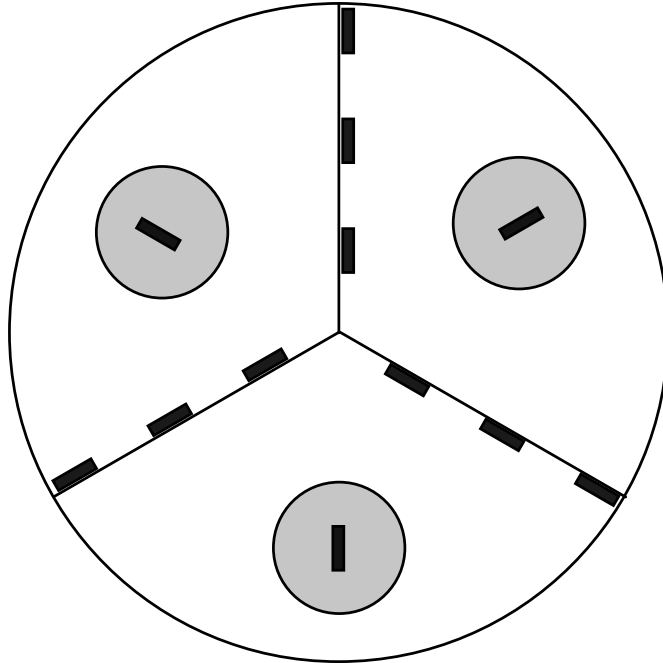


Figure 1. Layout of Forest Monitoring Plots. Trees are monitored within the 15m radius white circle. Saplings and shrubs are monitored within the 3m radius grey circles. Seedlings and select exotic and native herbaceous plants are monitored in the 1m² black quadrats. Coarse woody debris is measured on the 15m long transects emanating from the center of the plot.

Forest Communities in the National Capital Region

Tree Density and Basal Area

During 2007, a total of 2855 individual trees (dbh ≥ 10 cm) were tagged and measured (Table 2). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 10,500 individual trees.

Table 2. Tree density, basal area (BA) and species richness by park.

Park	Plots	Trees	Trees/ha	BA(cm ²)/ha	Species	Species/Plot
ANTI	3	71	335	324,000	17	8.7
CATO	17	384	320	280,000	23	6.8
CHOH	16	430	380	253,000	39	6.5
GWMP	8	176	311	313,000	25	6.5
HAFF	2	36	255	194,000	7	5.0
MANA	6	236	556	275,000	24	7.2
NACE	13	414	451	349,000	35	7.0
PRWI	33	1064	456	291,000	25	7.6
ROCR	2	43	304	444,000	10	5.0
Total	100	2854	404	294,000	62	7.0

The number of individual trees per plot varied from a high of 89 to a low of 8 in one plot. In general, plots found in the Piedmont (MANA, PRWI, and parts of other parks) have more trees/ha than those found in other ecoregions (Ridge and Valley, Blue Ridge, Southeastern Plains). Tree basal area on individual plots varied from 27,700 to a high of 40,600 cm²

In total, trees from 62 different tree species were found in the region, with most parks having considerably fewer. CHOH had the largest number of tree species, which is not surprising as many plots were located in the park and the park spans four different ecoregions. However, this year the highest average number of tree species per plot was found in Antietam. The number of tree species on individual plots varied from 1 to 13.

Sapling Density and Basal Area

During 2007, a total of 696 saplings (trees between 1 and 10 cm dbh) were tagged and measured (Table 3). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 3000 individual saplings.

In general, fewer saplings are monitored than trees. However, a smaller area is monitored for saplings (85 vs. 707m²), so on a per hectare basis saplings are more dense than trees. The number of saplings on an individual plot varied from seven plots with zero to a single plot with 53.

Table 3. Sapling density, basal area (BA) and species richness by park.

Park	Plots	Saplings	Saplings/ha	BA(cm ²)/ ha	Species	Species/Plot
ANTI	3	18	707	15,400	6	3.7
CATO	17	39	270	8660	15	1.4
CHOH	16	139	1020	19,600	24	2.8
GWMP	8	49	722	10,500	13	2.5
HAFE	2	15	884	12,600	6	4.0
MANA	6	32	629	17,800	12	3.0
NACE	13	87	789	14,900	16	2.4
PRWI	33	306	1090	20,800	18	3.2
ROCR	2	11	648	10,100	6	3.0
Total	100	696	821	16,200	47	2.7

Only 47 sapling species were present on the plots as compared to 62 trees species. Fewer individual saplings than trees were monitored, which likely accounts for some of this difference. The highest number of saplings species on a single plot was eight. As with trees, CHOH had the largest number of sapling species

Tree Seedling Density

During 2007, 557 seedlings (trees less than 1cm dbh and ≥ 15 cm height) were identified and their heights were measured (Table 4). We did not tag seedlings as this would be practically difficult and we expect them to have a high mortality rate.

Twenty-four plots had no seedlings, and an additional eight plots had only one. On the other hand, seven plots had over 40 seedlings, one of which had 61. There is considerable variation in seedling density across the region, even in relatively well sampled parks. Seedling density was notably low in Catoctin and Rock Creek parks.

A total of 42 tree species were found as seedlings on the plots, fewer than were found as trees or saplings. This is at least partially due to the fact that a smaller area was surveyed for seedlings and fewer individual tree seedlings were found than trees or saplings. The highest seedling species richness, 8 species, was found on a plot in Prince William Forest Park.

Table 4. Tree seedling density and richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
ANTI	3	14	3890	4	1.7
CATO	17	8	392	5	0.4
CHOH	16	42	2190	14	1.3
GWMP	8	38	3960	7	1.2
HAFE	2	30	12,500	6	3.5
MANA	6	33	4580	11	2.3
NACE	13	152	9740	16	2.4
PRWI	33	234	5910	23	2.4
ROCR	2	3	1250	2	1.0
Total	100	554	4620	42	1.8

Tree Species Diversity

Across the region, 68 species were found as trees, saplings and/or seedlings (Table 5). While many of these species were found in all three growth states, a majority were found in only one or two. Virginia pine (*Pinus virginiana*) is one of the most common species in terms of individual trees. It is absent in the sapling layer, as it only establishes in early successional forests (Burns and Honkala 1990), which were found on few plots. Pawpaw (*Asimina triloba*) is relatively rare as a large tree, but is a common species in both the sapling and seedling layer. Several local botanists have indicated to the NCRN that they believe this species is becoming more common, possibly because deer are browsing on competing species.

Table 5. Tree species found on the forest monitoring plots.

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	103	5410	49	890	15
¹ <i>Acer platanoides</i>	Norway maple	1	41	3	61	-
<i>Acer rubrum</i>	red maple	350	16,900	57	1480	19
<i>Acer saccharinum</i>	silver maple	36	5290	13	407	1
<i>Acer saccharum</i>	sugar maple	53	3020	5	205	-
¹ <i>Ailanthus altissima</i>	tree of heaven	9	427	-	-	-
<i>Amelanchier arborea</i>	common serviceberry	2	43	1	1	6
<i>Aralia spinosa</i>	devil's walkingstick	-	-	2	74	1
<i>Asimina triloba</i>	pawpaw	4	53	53	523	124
<i>Betula lenta</i>	sweet birch	35	3860	-	-	-
<i>Carpinus caroliniana</i>	American hornbeam	7	158	7	151	2
<i>Carya alba</i>	mockernut hickory	52	2690	7	160	8
<i>Carya cordiformis</i>	bitternut hickory	12	709	4	71	3
<i>Carya glabra</i>	pignut hickory	51	3520	9	288	5
<i>Carya ovalis</i>	red hickory	8	871	1	11	-
<i>Carya ovata</i>	shagbark hickory	9	590	2	117	-
<i>Castanea pumila</i>	chinkapin	-	-	-	-	1
<i>Celtis occidentalis</i>	common hackberry	17	671	9	268	8
<i>Cercis canadensis</i>	eastern redbud	1	15	7	137	5
<i>Chionanthus virginicus</i>	white fringetree	-	-	1	32	-
<i>Cornus amomum</i>	silky dogwood	-	-	-	-	1
<i>Cornus florida</i>	flowering dogwood	16	271	33	1060	1
<i>Crataegus crus-galli</i>	cockspur hawthorn	1	13	5	244	-
<i>Diospyros virginiana</i>	common persimmon	4	175	1	6	1
<i>Fagus grandifolia</i>	American beech	188	6690	120	2150	20
<i>Fraxinus americana</i>	white ash	115	9360	24	560	33
<i>Fraxinus pennsylvanica</i>	green ash	63	7170	5	133	2
<i>Ilex opaca</i>	American holly	70	1420	60	1510	42
<i>Juglans nigra</i>	black walnut	11	1960	2	120	1
<i>Juniperus virginiana</i>	eastern red cedar	96	3920	3	209	-
<i>Liquidambar styraciflua</i>	sweetgum	58	5860	31	572	71
<i>Liriodendron tulipifera</i>	tuliptree	230	57,200	4	147	3
¹ <i>Maclura pomifera</i>	Osage orange	4	208	-	-	-
¹ <i>Magnolia grandiflora</i>	southern magnolia	7	1010	-	-	1
¹ <i>Malus sieboldii</i>	toringa crabapple	1	12	1	2	-
¹ <i>Morus alba</i>	white mulberry	17	1160	-	-	-
<i>Morus rubra</i>	red mulberry	1	30	1	7	-
<i>Nyssa sylvatica</i>	blackgum	165	5560	91	2390	8
<i>Ostrya virginiana</i>	hophornbeam	6	128	11	205	-
<i>Pinus pungens</i>	Table Mountain pine	1	135	-	-	-

Table 6. Tree species found on the forest monitoring plots (continued).

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Pinus rigida</i>	pitch pine	3	277	-	-	-
<i>Pinus strobus</i>	eastern white pine	4	329	1	20	-
<i>Pinus virginiana</i>	Virginia pine	241	24,800	-	-	3
<i>Platanus</i>	American	19	4340	-	-	-
<i>occidentalis</i>	sycamore					
<i>Populus deltoides</i>	eastern cottonwood	5	1670	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	4	370	2	99	2
<i>Prunus serotina</i>	black cherry	42	5820	7	176	17
¹ <i>Pyrus communis</i>	common pear	1	15	-	-	-
<i>Quercus alba</i>	white oak	206	29,000	14	318	53
<i>Quercus bicolor</i>	swamp white oak	1	14	-	-	-
<i>Quercus coccinea</i>	scarlet oak	78	14,800	2	124	5
<i>Quercus falcata</i>	southern red oak	20	3120	4	37	3
<i>Quercus ilicifolia</i>	bear oak	-	-	2	14	1
<i>Quercus</i>	chinkapin oak	2	143	-	-	-
<i>muehlenbergii</i>						
<i>Quercus palustris</i>	pin oak	7	1310	1	8	5
<i>Quercus phellos</i>	willow oak	7	2030	-	-	1
<i>Quercus prinus</i>	chestnut oak	171	26,700	4	81	60
<i>Quercus rubra</i>	northern red oak	75	18,200	3	108	1
<i>Quercus shumardii</i>	Shumard's oak	1	305	-	-	-
<i>Quercus stellata</i>	post oak	2	287	-	-	-
<i>Quercus velutina</i>	black oak	30	5510	3	21	6
<i>Quercus</i> spp.	oak	-	-	-	-	2
<i>Robinia</i>	black locust	17	1580	-	-	-
<i>pseudoacacia</i>						
<i>Sassafras albidum</i>	sassafras	35	1070	10	369	9
¹ <i>Sophora japonica</i>	Japanese pagoda tree	-	-	1	20	1
<i>Tilia americana</i>	American basswood	8	718	-	-	-
<i>Tsuga canadensis</i>	eastern hemlock	2	870	-	-	-
<i>Ulmus americana</i>	American elm	61	3440	14	381	4
<i>Ulmus rubra</i>	slippery elm	8	280	6	295	1

¹Non-native species.

Shrub Density

During 2007, a total of 596 individuals from 21 shrub species (typically multi-stemmed with a diameter at root crown ≥ 1 cm [Appendix B]) were tagged and measured on the microplots in each plot (Table 6). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 1500 shrubs. Some species that are commonly considered shrubs, such as multi-flora rose (*Rosa multiflora*) often grow as a dense cover that makes it difficult to delineate individual plants. These species are monitored by measuring their cover on the quadrats, as it is impractical to tag and measure individuals. Shrubs are much less common than trees; 52 plots did not contain any shrubs.

Shrub richness is considerably lower than that of trees. No plot contained more than two shrub species.

Table 7. Shrub density and species richness by park.

Park	Plots	Shrubs	Shrubs per ha	BA(cm ²)/ha	Species	Species/ Plot
ANTI	3	5	196	23,700	2	1.0
CATO	17	93	645	110,000	3	0.8
CHOH	16	44	324	18,700	1	0.3
GWMP	8	80	1180	29,100	4	0.6
HAFE	2	43	2540	94,400	1	1.0
MANA	6	2	39	1140	2	0.3
NACE	13	94	852	93,500	7	1.1
PRWI	33	176	629	30,800	4	0.6
ROCR	2	59	3480	155,000	3	2.0
Total	100	596	703	44,100	13	0.7

Shrub Seedling Density

A total of 435 shrub seedlings were found across all of the plots, far fewer than the number of tree seedlings found (Table 7). Only 38 plots had shrub seedlings present.

Shrub seedling density varied greatly across parks. HAFE had much higher densities than the other parks, where as MANA had very few.

Sixteen different shrubs were present as seedlings (Table 8).

Table 8. Shrub seedling density and species richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
ANTI	3	6	1670	2	1.3
CATO	17	96	4710	2	0.4
CHOH	16	27	1410	1	0.3
GWMP	8	56	5830	2	0.2
HAFE	2	72	30,000	1	1.0
MANA	6	2	278	1	0.2
NACE	13	93	5960	9	1.2
PRWI	33	65	1640	5	0.3
ROCR	2	18	7500	3	1.5
Total	100	435	3620	16	0.5

Shrub Species Diversity

Two shrub species, northern spicebush (*Lindera benzoin*) and mountain laurel (*Kalmia latifolia*) make up over 80% of individual shrubs (Table 8). These two species also accounted for over 84% of all shrub seedlings. The other native species are relatively rare across the region.

Table 9. Shrub species found on the forest monitoring plots.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Elaeagnus umbellata</i>	autumn olive	1	-
<i>Euonymus americana</i>	bursting-heart	-	2
<i>Euonymus atropurpureus</i>	burningbush	-	1
<i>Gaylussacia frondosa</i>	blue huckleberry	-	6
<i>Hamamelis virginiana</i>	American witchhazel	22	-
<i>Ilex verticillata</i>	common winterberry	19	2
<i>Kalmia latifolia</i>	mountain laurel	196	50
¹ <i>Ligustrum</i> spp.	privet	1	-
<i>Lindera benzoin</i>	northern spicebush	292	317
¹ <i>Lonicera maackii</i>	amur honeysuckle	5	2
<i>Lyonia ligustrina</i>	maleberry	-	12
<i>Rhododendron periclymenoides</i>	pink azalea	-	13
<i>Rubus argutus</i>	sawtooth blackberry	-	1
<i>Sambucus pubens</i>	red elderberry	-	1
<i>Vaccinium corymbosum</i>	highbush blueberry	19	9
<i>Vaccinium fuscum</i>	black highbush blueberry	7	-
<i>Viburnum dentatum</i>	southern arrow wood	2	14
¹ <i>Viburnum plicatum</i>	Japanese snowball	3	1
<i>Viburnum prunifolium</i>	blackhaw	6	4
¹ <i>Viburnum sieboldii</i>	Siebold's arrowwood	23	-

¹Non-native species.

Coarse Woody Debris

Coarse woody debris (CWD) was measured using the line-intersect method (Van Wagner 1968) on three 15 m long transects in each plot. On average, there were 56 m³ per ha of CWD ≥ 7.5 cm diameter across all plots (Table 9).

Table 10. Mean coarse woody debris by park.

Park Code	Plots	Coarse woody debris m ³ /ha
ANTI	3	51
CATO	17	81
CHOH	16	30
GWMP	8	50
HAFE	2	54
MANA	6	48
NACE	13	50
PRWI	33	65
ROCR	2	19
Total	100	56

Forest Pests and Diseases in the National Capital Region

Forest pests and diseases were selected as one of the 21 vital signs for the parks in NCRN. Forests in the parks have historically been impacted by pests such as the gypsy moth, and diseases such as the chestnut blight. Trees on the forest monitoring plot were monitored for a select group of pests and diseases (Appendix A). The list will be reviewed annually for appropriate additions or removals.

In 2007, the only pest found on the monitored trees was the gypsy moth. In Catoclin, Gypsy moths were found on 16 trees of red maple (*Acer rubrum*), three trees of silver maple (*Acer saccharum*), two of sweet birch (*Betula lenta*), two of blackgum (*Nyssa sylvatica*), three of white oak (*Quercus alba*), 37 of chestnut oak (*Quercus prinus*), 11 of northern red oak (*Quercus rubra*), and one each of mockernut hickory (*Carya alba*), shagbark hickory (*Carya ovata*), tulip tree (*Liriodendron tulipifera*), scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*) and sassafras (*Sassafras albidum*). One silver maple tree along George Washington Memorial Parkway also was infested with gypsy moth.

Exotic Plant Species in the National Capital Region

Many exotic plant species are found in the parks that make up the NCRN. Exotic plant species can exclude native species, may be less suitable for wildlife, and may have negative impacts on other aspects of the ecosystem such as soil quality.

The NCRN is measuring distribution and abundance of exotic plants species using the forest monitoring plots. Exotic trees, vines, shrubs and select herbaceous plants are monitored.

Exotic Tree Species

Of the 62 species found as trees, eight are not native to the region (Table 5). Combined these species are represented by 44 individuals trees, which make up 1.5% of all trees and 1.1% of all tree basal area.

Four sapling species are not native to the region. Combined these species are represented by only 7 individuals which make up 1.0% of all saplings and 1.1% of all sapling basal area.

Seedlings of three exotic species were found. Only four individual seedlings were found from all of these species combined which is 0.7% of all seedlings.

Based on the data collected in 2007, exotic tree species are present throughout the region but they represent a localized problem and are not currently a broad threat to forest communities.

Vines in Trees

The NCRN does not tag and monitor individual vines. However, vines are identified when they grow on tagged trees. Vines are noted and identified regardless of whether they are native, exotic, invasive, or non-invasive. Additionally, exotic vines which occur as cover on the quadrats are also monitored (see below).

In all, 546 trees, 19% of all marked trees, had vines growing on them (Table 10). Of these, 148 (5.2%) had vines growing in the crown of the tree. Vines that grow in the crowns of trees could increase tree mortality by shading leaves or toppling trees due to the increased weight. Vines in trees are particularly common in some parks, such as CHOH and NACE where forest edge is more common.

Table 11. Presence of vines in trees by park.

Park	Plots	Trees	Trees with Vines	Tree with vines in crown
ANTI	3	71	15	1
CATO	17	384	34	24
CHOH	16	430	115	28
GWMP	8	176	71	19
HAFF	2	36	3	-
MANA	6	236	83	45
NACE	13	414	139	27
PRWI	33	1064	49	2
ROCR	2	43	33	2
Total	100	2854	542	148

Of the 13 species or genera of vines found, eight were exotic species (Table 11). In total, 244 trees had exotic vines growing on them and of these, 68 had exotic vines growing in the crown of the tree. Native species, including poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*) and wild grape (*Vitis* spp.) were also very common.

Table 12. Species of vines in trees.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	5	4
<i>Campsis radicans</i>	trumpet creeper	16	5
¹ <i>Celastrus orbiculatus</i>	oriental bittersweet	9	6
¹ <i>Euonymus fortunei</i>	creeping euonymus	25	2
¹ <i>Hedera helix</i>	English ivy	92	18
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	82	29
¹ <i>Lonicera</i> spp.	honeysuckle	1	-
<i>Parthenocissus quinquefolia</i>	Virginia creeper	154	32
¹ <i>Polygonum perfoliatum</i>	Asiatic tearthumb	3	3
¹ <i>Rosa multiflora</i>	multiflora rose	8	2
<i>Smilax</i> spp.	greenbrier	91	11
<i>Toxicodendron radicans</i>	poison ivy	157	23
<i>Vitis</i> spp.	grape	143	102
¹ <i>Wisteria sinensis</i>	Chinese wisteria	19	4

¹Non-native species.

Not all tree species were equally impacted by vines (Table 12). For nineteen tree species, over 10% of all individual trees have vines in their crowns.

Table 13. Tree species affected by vines.

Tree Species	Trees	Trees with Vines	Trees with Vines in Crown
<i>Acer negundo</i>	103	61	13
¹ <i>Acer platanoides</i>	1	1	-
<i>Acer rubrum</i>	350	36	6
<i>Acer saccharinum</i>	36	21	6
<i>Acer saccharum</i>	53	5	3
¹ <i>Ailanthus altissima</i>	9	5	2
<i>Amelanchier arborea</i>	2	1	-
<i>Asimina triloba</i>	4	2	2
<i>Betula lenta</i>	35	2	2
<i>Carpinus caroliniana</i>	7	2	1
<i>Carya alba</i>	52	1	-
<i>Carya cordiformis</i>	12	2	1
<i>Carya glabra</i>	51	1	1
<i>Carya ovata</i>	9	2	1
<i>Celtis occidentalis</i>	17	2	-
<i>Crataegus crus-galli</i>	1	1	-
<i>Diospyros virginiana</i>	4	3	1
<i>Fagus grandifolia</i>	188	11	5
<i>Fraxinus americana</i>	115	34	11
<i>Fraxinus pennsylvanica</i>	63	37	2
<i>Ilex opaca</i>	70	14	2
<i>Juglans nigra</i>	11	3	-
<i>Juniperus virginiana</i>	96	39	30
<i>Liquidambar styraciflua</i>	58	24	1
<i>Liriodendron tulipifera</i>	230	30	-
¹ <i>Maclura pomifera</i>	4	4	3
¹ <i>Magnolia grandiflora</i>	7	7	1
¹ <i>Morus alba</i>	17	14	5
<i>Morus rubra</i>	1	1	1
<i>Nyssa sylvatica</i>	165	8	4
<i>Pinus rigida</i>	3	2	1
<i>Pinus virginiana</i>	241	35	8
<i>Platanus occidentalis</i>	19	10	1
<i>Populus deltoides</i>	5	5	2
¹ <i>Prunus avium</i>	4	2	-
<i>Prunus serotina</i>	42	23	9
<i>Quercus alba</i>	206	5	-
<i>Quercus bicolor</i>	1	1	-
<i>Quercus coccinea</i>	78	2	-
<i>Quercus falcata</i>	20	1	-
<i>Quercus palustris</i>	7	4	1
<i>Quercus phellos</i>	7	5	-
<i>Quercus prinus</i>	171	2	1
<i>Quercus rubra</i>	75	3	-
<i>Quercus shumardii</i>	1	1	-
<i>Robinia pseudoacacia</i>	17	12	5
<i>Sassafras albidum</i>	35	17	5
<i>Tilia americana</i>	8	2	2
<i>Tsuga canadensis</i>	2	1	-
<i>Ulmus americana</i>	61	34	5
<i>Ulmus rubra</i>	8	1	1

¹Non-native species.

Exotic Shrubs

Of the twenty shrub species found (Table 8), five are exotic. Only one species had more than five individual shrubs. Siebold's arrowwood (*Viburnum sieboldii*) was represented by 23 individual shrubs in a single plot (ROCR-186) along the Rock Creek and Potomac Parkway. Only 33 exotic shrubs and three exotic shrub seedlings were found. Together these represent 5.5 % of all individual shrubs, and 0.7% of all shrub seedlings.

Exotic Herbaceous Plants

On each plot, 12 quadrats measuring 0.5×2m are surveyed for targeted exotic plants. These include herbaceous exotics as well as some vines and shrubs such as multi-flora rose (*Rosa multiflora*) which cannot practically be monitored by tagging individual plants. Of the 100 plots monitored in 2007, 53 had invasive species on at least 1 quadrat (Table 13). No park was free from such species. The percent of plots with herbaceous exotics varies considerably between parks.

Table 14. Frequency of exotic herbaceous plants by park.

Park	Plots	Plots with exotic herbs	% of plots with exotic herbs	Quadrats with exotics per plot with exotics
ANTI	3	3	100%	11.7
CATO	17	8	47%	8.4
CHOH	16	11	69%	8.8
GWMP	8	6	75%	9.7
HAFE	2	2	100%	9.5
MANA	6	6	100%	8.2
NACE	13	10	77%	7.2
PRWI	33	5	15%	3.2
ROCR	2	2	100%	12.0
Total	100	53	53%	8.2

Fifteen exotic plant species were detected on the quadrats (Table 14). While most of the species were not widespread, several are found on a large number of plots throughout the region. These include three species, Japanese honeysuckle (*Lonicera japonica*), Japanese barberry (*Berberis thunbergii*) and multi-flora rose, that have a shrub or vine-like growth and two species, garlic mustard (*Alliaria petiolata*), and Japanese stiltgrass (*Microstegium vimineum*), that are understory herbs. Some species, such as English ivy (*Hedera helix*) and common periwinkle (*Vinca minor*) can cover a large percentage of the quadrats and plots where they are found.

Table 15. Cover of exotic plants.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	23	6%
<i>Ampelopsis brevipedunculata</i>	Amur peppervine	3	16%
<i>Berberis thunbergii</i>	Japanese barberry	12	2%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	7	2%
<i>Duchesnea indica</i>	Indian strawberry	6	5%
<i>Euonymus fortunei</i>	winter creeper	4	4%
<i>Glechoma hederacea</i>	ground ivy	2	<1%
<i>Hedera helix</i>	English Ivy	7	28%
<i>Lonicera japonica</i>	Japanese honeysuckle	33	4%
<i>Lonicera</i> spp.	honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	27	13%
<i>Polygonum perfoliatum</i>	mile-a-minute	2	9%
<i>Rosa multiflora</i>	multiflora rose	11	3%
<i>Rubus phoenicolasius</i>	wine raspberry	7	4%
<i>Vinca minor</i>	common periwinkle	2	28%
<i>Wisteria sinensis</i>	Chinese wisteria	1	14%

Antietam National Battlefield

Three plots were monitored in Antietam in 2007 (Figure 2).

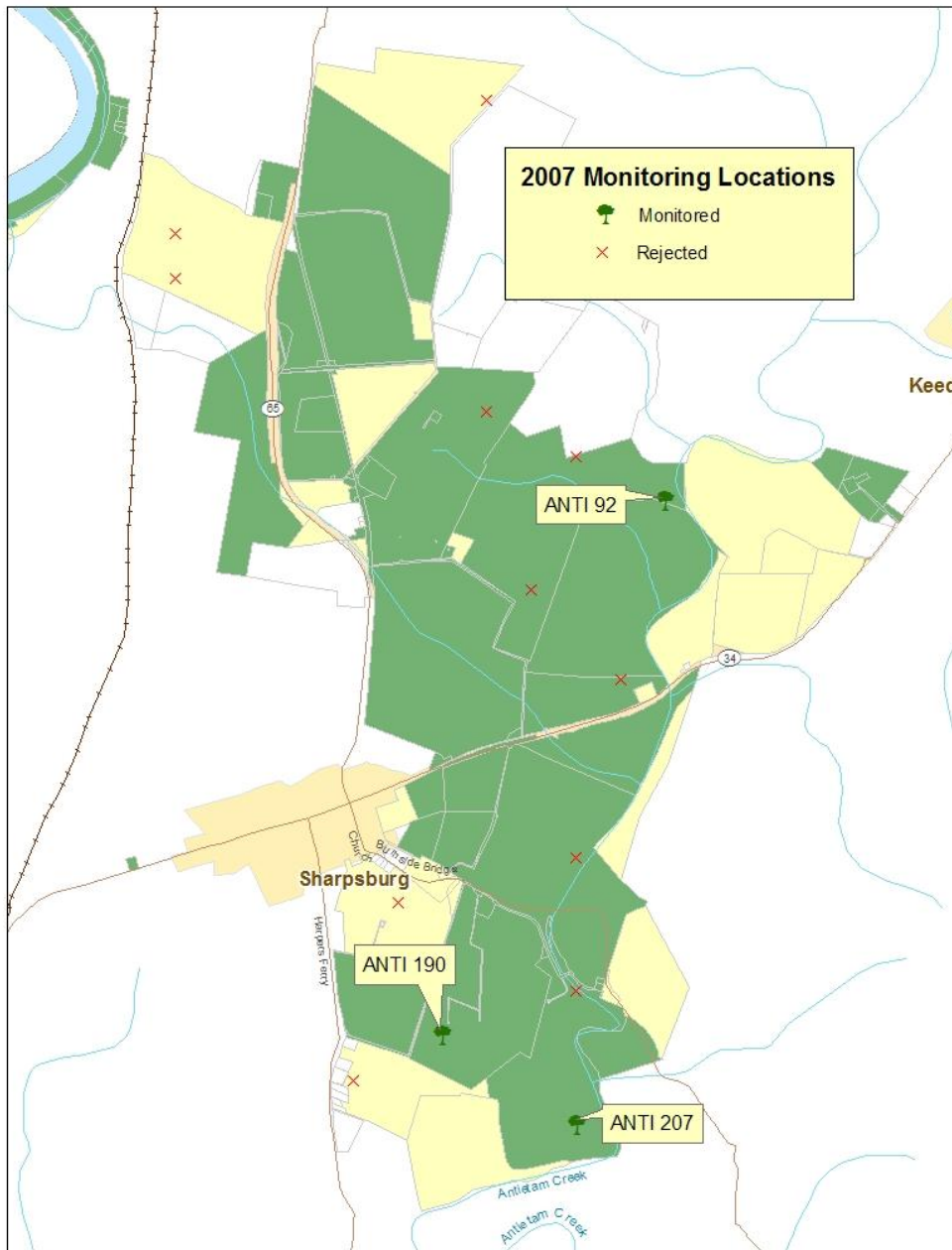


Figure 2. Locations considered for forest monitoring in Antietam.

Forest Communities

Density and basal area information for the Antietam plots can be found in Table 15. In total, seventeen tree species were found (Table 16).

Table 16. Density, basal area (BA) and species richness of trees, saplings and seedlings in Antietam.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings /ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Seedling Species
ANTI-0092	16	226	279,000	9	6	707	22,400	4	2	1670	1
ANTI-0190	29	410	302,000	8	8	943	19,100	4	9	7500	3
ANTI-0207	26	368	390,000	9	4	472	4670	3	3	2000	1
Total	71	335	324,000	17	18	707	15,400	6	14	3890	4

Table 17. Tree species found on the forest monitoring plots in Antietam.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	boxelder	8	4820	1/-	5	3500	3
<i>Acer saccharum</i>	sugar maple	1	750	-	-	-	-
<i>Asimina triloba</i>	pawpaw	-	-	-	3	275	5
<i>Carya alba</i>	mockernut	1	6720	-	-	-	-
	hickory						
<i>Carya</i>	bitternut	7	17,400	-	1	1610	-
<i>cordiformis</i>	hickory						
<i>Celtis</i>	common	10	16,700	1/-	6	5860	4
<i>occidentalis</i>	hackberry						
<i>Fagus</i>	American	2	5670	-	-	-	-
<i>grandifolia</i>	beech						
<i>Fraxinus</i>	white ash	6	17,200	-	1	157	-
<i>americana</i>							
<i>Juglans nigra</i>	black walnut	2	13,900	-	2	4010	-
<i>Juniperus</i>	eastern	4	10,100	1/1	-	-	-
<i>virginiana</i>	redcedar						
<i>Liriodendron</i>	tuliptree	5	136,000	1/-	-	-	-
<i>tulipifera</i>							
¹ <i>Morus alba</i>	white mulberry	8	16,600	5/-	-	-	-
<i>Platanus</i>	American	1	43,400	-	-	-	-
<i>occidentalis</i>	sycamore						
<i>Prunus serotina</i>	black cherry	8	16,600	3/-	-	-	2
<i>Quercus</i>	chinkapin	1	3890	-	-	-	-
<i>muehlenbergii</i>	oak						
<i>Quercus rubra</i>	northern red oak	1	4300	-	-	-	-
<i>Robinia pseudo-acacia</i>	black locust	3	7260	2/-	-	-	-
<i>Ulmus</i>	American	3	2430	1/-	-	-	-
<i>americana</i>	elm						

¹Non-native species.

Few shrubs were found on the monitoring plots in Antietam (Table 17).

Table 18. Density, basal area, seedling density and species richness of shrubs in Antietam.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
ANTI-0092	2	236	2	41,900	2	1670
ANTI-0190	-	-	-	-	1	833
ANTI-0207	3	354	1	29,200	3	2500
Total	5	196	2	23,700	6	1670

Northern spicebush (*Lindera benzoin*) was the most commonly found shrub (Table 18).

Table 19. Shrub species found in Antietam.

Latin Name	Common Name	Shrubs	Seedlings
<i>Euonymus atropurpureus</i>	burningbush	-	1
<i>Lindera benzoin</i>	northern spicebush	4	5
<i>Viburnum prunifolium</i>	blackhaw	1	-

Forest Pests and Diseases

None of the targeted forest pests or diseases were found in Antietam.

Exotic Plant Species

Exotic Tree Species

Only one exotic trees species was found on the plots in Antietam. Five individuals of white mulberry (*Morus alba*) occurred on ANTI-190, which is in a small forest patch to the east of Branch Avenue. These make up 7.0% of all trees and 5.1% of all tree basal area.

Vines in Trees

Although 15 trees, 21% of all trees in the plots, have vines, only 1 tree has vines in the crown (Table 19).

Table 20. Presence of vines in Antietam.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
ANTI-0092	16	-	-
ANTI-0190	29	13	1
ANTI-0207	26	2	-
Total	71	15	1

Only three of the trees have vines that are exotic. All of the exotic vines are Japanese honeysuckle (*Lonicera japonica*) in plot ANTI-190 (Table 20).

Table 21. Species of vines in trees in Antietam.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	3	0
<i>Parthenocissus quinquefolia</i>	Virginia creeper	8	1
<i>Smilax</i> spp.	greenbrier	1	0
<i>Toxicodendron radicans</i>	eastern poison ivy	4	0

¹Non-native species.

Exotic Shrubs

No non-native shrubs were found.

Exotic Herbaceous Species

Nearly all of the quadrats in all three plots had exotic herbaceous species present on them (Table 21).

Table 22. Presence of exotic herbaceous plants in Antietam.

Plot	Quadrats with Exotics	Number of Exotic Species
ANTI-0092	12	3
ANTI-0190	12	6
ANTI-0207	11	1
Total	35	7

Six exotic species were found on the plots (Table 22). The most common was garlic mustard (*Alliaria petiolata*) which was found on all three plots.

Table 23. Cover of exotic plants in Antietam.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	3	10%
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Duchesnea indica</i>	Indian strawberry	1	6%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	9%
<i>Microstegium vimineum</i>	Japanese stiltgrass	2	8%
<i>Rosa multiflora</i>	multiflora rose	1	13%
<i>Rubus phoenicolasius</i>	Wine raspberry	1	14%

Catoctin Mountain Park

Seventeen plots were monitored in Catoctin in 2007 (Figure 3).

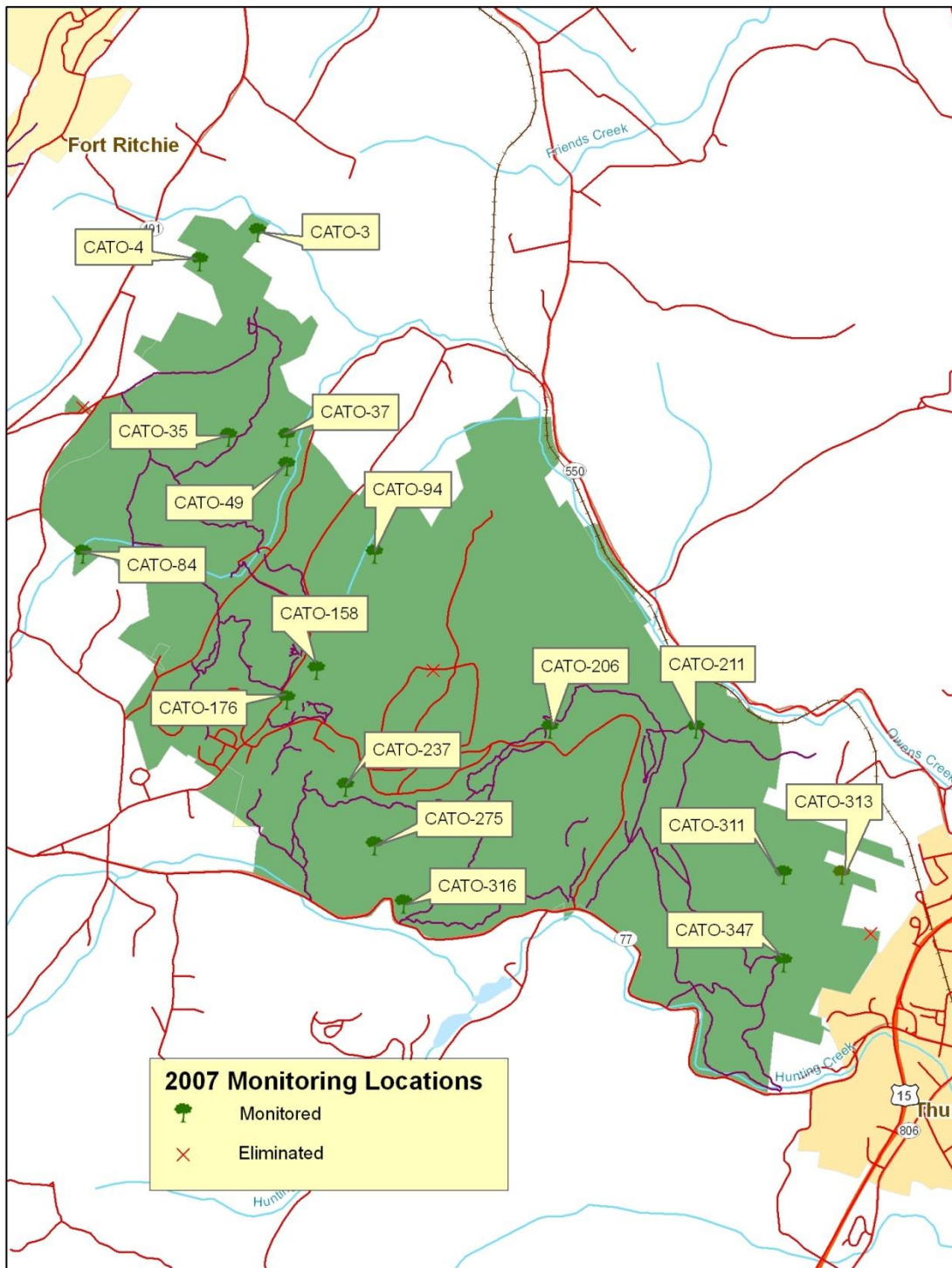


Figure 3. Locations considered for forest monitoring in Catoctin.

Forest Communities

There is considerable variation in tree and sapling density and basal area among plots in Catoctin (Table 23). There were no saplings in the microplots on four of the plots.

Only eight seedlings were found in Catoctin. Seedling density is less than one-tenth that of the region as a whole. On the quadrats of thirteen plots, no seedlings were found.

Table 24. Density, basal area (BA) and species richness of trees, saplings and seedlings in Catoctin.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings /ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Seedling Species
CATO-0003	21	297	415,000	8	2	236	12,800	1	-	-	-
CATO-0004	25	354	302,000	9	-	-	-	-	-	-	-
CATO-0035	19	269	431,000	3	-	-	-	-	-	-	-
CATO-0037	13	184	150,000	8	-	-	-	-	3	2500	2
CATO-0049	30	424	161,000	8	3	354	14,500	2	-	-	-
CATO-0084	21	297	296,000	7	9	1060	17,600	3	-	-	-
CATO-0094	18	255	207,000	6	1	118	9080	1	-	-	-
CATO-0158	29	410	308,000	8	3	354	9930	2	1	833	1
CATO-0176	19	269	187,000	8	3	354	8570	3	-	-	-
CATO-0206	23	325	275,000	5	2	236	3580	1	-	-	-
CATO-0211	31	439	261,000	6	2	236	11,800	1	1	833	1
CATO-0237	22	311	323,000	6	1	118	4940	1	-	-	-
CATO-0275	21	297	239,000	8	4	472	17,600	3	-	-	-
CATO-0311	17	241	327,000	7	-	-	-	-	3	2500	2
CATO-0313	32	453	208,000	5	2	236	5200	1	-	-	-
CATO-0316	23	325	369,000	7	2	236	15,500	2	-	-	-
CATO-0347	20	283	300,000	6	5	589	16,300	3	-	-	-
Total	384	320	280,000	23	39	270	8660	14	8	392	5

In total, 27 tree species were found in Catoctin (Table 24).

Table 25. Tree species found in Catoctin.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	79	26,200	4/4	6	1520	-
<i>Acer saccharum</i>	sugar maple	52	17,700	5/3	5	1210	-
¹ <i>Ailanthus</i>	tree of heaven	2	216	-	-	-	-
<i>altissima</i>							
<i>Aralia spinosa</i>	devil's walkingstick	-	-	-/-	-	-	1
<i>Betula lenta</i>	sweet birch	35	22,700	2/2	-	-	-
<i>Carpinus</i>	American	1	73	-	1	208	-
<i>caroliniana</i>	hornbeam						
<i>Carya alba</i>	mockernut	1	114	-	1	139	-
	hickory						
<i>Carya</i>	bitternut	-	-	-	1	14	2
<i>cordiformis</i>	hickory						
<i>Carya glabra</i>	pignut hickory	4	765	-	1	277	-
<i>Carya ovalis</i>	red hickory	4	1850	-	-	-	-
<i>Carya ovata</i>	shagbark hickory	9	3470	2/1	2	687	-
<i>Celtis</i>	common	-	-	-	1	69	-
<i>occidentalis</i>	hackberry						
<i>Cornus florida</i>	flowering dogwood	-	-	-	2	680	-
<i>Fagus</i>	American beech	13	4000	4/4	3	1140	-
<i>grandifolia</i>							
<i>Fraxinus</i>	white ash	30	22,600	4/4	-	-	-
<i>americana</i>							
<i>Liriodendron</i>	tuliptree	14	32,000	2/-	-	-	-
<i>tulipifera</i>							
<i>Nyssa sylvatica</i>	blackgum	20	5720	3/3	5	1050	2
<i>Ostrya virginiana</i>	hophornbeam	6	753	-	8	874	-
<i>Prunus serotina</i>	black cherry	3	1290	1/-	2	617	-
<i>Quercus alba</i>	white oak	3	5400	-	-	-	-
<i>Quercus</i>	scarlet oak	1	824	-	-	-	-
<i>coccinea</i>							
<i>Quercus prinus</i>	chestnut oak	58	54,800	2/1	1	166	1
<i>Quercus rubra</i>	northern red oak	36	73,200	3/-	-	-	-
<i>Quercus velutina</i>	black oak	1	1250	-	-	-	-
<i>Robinia</i>	black locust	1	186	-	-	-	-
<i>pseudoacacia</i>							
<i>Sassafras</i>	sassafras	3	563	-	-	-	2
<i>albidum</i>							
<i>Tilia americana</i>	American basswood	8	4220	2/2	-	-	-

¹Non-native species.

Shrubs were found on all but four plots (Table 25). Shrub density was highest on plots in the northwestern portion of the park.

Table 26. Density, basal area, seedling density and species richness of shrubs in Catoctin.

Plot	Shrubs	Shrubs per ha	Species	BA (cm ²)/ha	Seedlings	Seedlings/ha
CATO-0003	6	707	2	192,000	21	17,500
CATO-0004	33	3890	1	144,000	54	45,000
CATO-0035	2	236	1	171,000	-	-
CATO-0037	20	2360	1	693,000	11	9170
CATO-0049	7	825	1	60,500	4	3330
CATO-0084	4	472	1	17,700	-	-
CATO-0094	1	118	1	2400	1	833
CATO-0158	-	-	-	-	1	833
CATO-0176	8	943	1	57,500	4	3330
CATO-0206	-	-	-	-	-	-
CATO-0211	1	118	1	4280	-	-
CATO-0237	3	354	1	119,000	-	-
CATO-0275	1	118	1	118,000	-	-
CATO-0311	-	-	-	-	-	-
CATO-0313	1	118	1	3910	-	-
CATO-0316	6	707	1	279,000	-	-
CATO-0347	-	-	-	-	-	-
Total	93	645	4	110,000	96	4700

Four species of shrub were found, all of which are native (Table 26).

Table 27. Shrub species found in Catoctin.

Latin Name	Common Name	Shrubs	Seedlings
<i>Hamamelis virginiana</i>	American witchhazel	20	-
<i>Kalmia latifolia</i>	mountain laurel	1	-
<i>Lindera benzoin</i>	northern spicebush	71	95
<i>Sambucus pubens</i>	red elderberry	-	1

Forest Pests and Diseases

In Catoctin Gypsy moths were found on 16 trees of red maple (*Acer rubrum*), three trees of silver maple (*Acer saccharum*), two of sweet birch (*Betula lenta*), two of blackgum (*Nyssa sylvatica*), three of white oak (*Quercus alba*), 37 of chestnut oak (*Quercus prinus*), 11 of northern red oak (*Quercus rubra*), and one each of mockernut hickory (*Carya alba*), shagbark hickory (*Carya ovata*), tulip tree (*Liriodendron tulipifera*), scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*) and sassafras (*Sassafras albidum*). Gypsy moths were found in plots CATO-0003, -0035, -00158, -0206, -0211, -0237, -0275, -0311, -0313, -0316, -0347. While gypsy moths were found throughout much of the park, the heaviest infestations were in the eastern half.

Exotic Plant Species

Exotic Trees

Only one exotic tree species was found in Catoctin. Two individuals of tree of heaven (*Ailanthus altissima*) were found, both in plot CATO-0049 on the west side of Foxville-Deerfield road.

Exotic Vines

Only 9% of trees had vines on them, compared to 19% in the region as a whole. 6.2% of trees had vines in the crown, compared to only 5.2% of trees in the region as a whole. Nearly half of the trees with vines in the crown were on a single plot, CATO-0037, which is on a slope to the west of Foxville-Deerfield road.

Table 28. Presence of vines in Catoctin.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CATO-0003	21	2	1
CATO-0004	25	4	2
CATO-0035	19	1	-
CATO-0037	13	11	10
CATO-0049	30	4	3
CATO-0084	21	-	-
CATO-0094	18	1	1
CATO-0158	29	-	-
CATO-0176	19	-	-
CATO-0206	23	-	-
CATO-0211	31	-	-
CATO-0237	22	7	5
CATO-0275	21	4	2
CATO-0311	17	-	-
CATO-0313	32	-	-
CATO-0316	23	-	-
CATO-0347	20	-	-
Total	384	34	24

Four native vines were found growing on trees in Catoctin. Wild grape (*Vitis* spp.) was the most common, found on 31 trees. Only one exotic species, Asiatic tearthumb (*Polygonum perfoliatum*), was found growing on trees.

Table 29. Species of vines in trees in Catoctin.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Parthenocissus quinquefolia</i>	Virginia creeper	3	3
¹ <i>Polygonum perfoliatum</i>	Asiatic tearthumb	3	3
<i>Smilax</i> spp.	greenbrier	1	-
<i>Toxicodendron radicans</i>	eastern poison ivy	2	-
<i>Vitis</i> spp.	grape	31	24

¹Non-native species.

Exotic Shrubs

No exotic shrubs were found in Catoctin.

Exotic Herbaceous Species

Eight of the seventeen plots monitored had exotic herbaceous species (Table 29). On average, 32% of the quadrats had exotic plants in Catoctin, as compared to 53% in the region as a whole.

Table 30. Presence of exotic herbaceous plants in Catoctin.

Plot	Quadrats with Exotics	Number of Exotic Species
CATO-0003	11	3
CATO-0004	3	1
CATO-0035	-	-
CATO-0037	12	5
CATO-0049	9	2
CATO-0084	-	-
CATO-0094	9	4
CATO-0158	7	3
CATO-0176	12	4
CATO-0206	-	-
CATO-0211	-	-
CATO-0237	-	-
CATO-0275	4	1
CATO-0311	-	-
CATO-0313	-	-
CATO-0316	-	-
CATO-0347	-	-
Total	67	6

Six exotic species were found on the plots. Garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*) and Japanese stiltgrass (*Microstegium vimineum*) were the most common (Table 30).

Table 31. Cover of exotic plants in Catoctin.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	6	3%
<i>Berberis thunbergii</i>	Japanese barberry	6	1%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	6	11%
<i>Polygonum perfoliatum</i>	Asiatic tearthumb	1	18%
<i>Rubus phoenicolasius</i>	wine raspberry	3	1%

Chesapeake and Ohio Canal National Historical Park

Sixteen plots were monitored on the C&O Canal in 2007. The plots were located along the length of the canal (Figure 4).

Forest Communities

There is considerable variation in all measures relating to trees across the plots (Table 31).

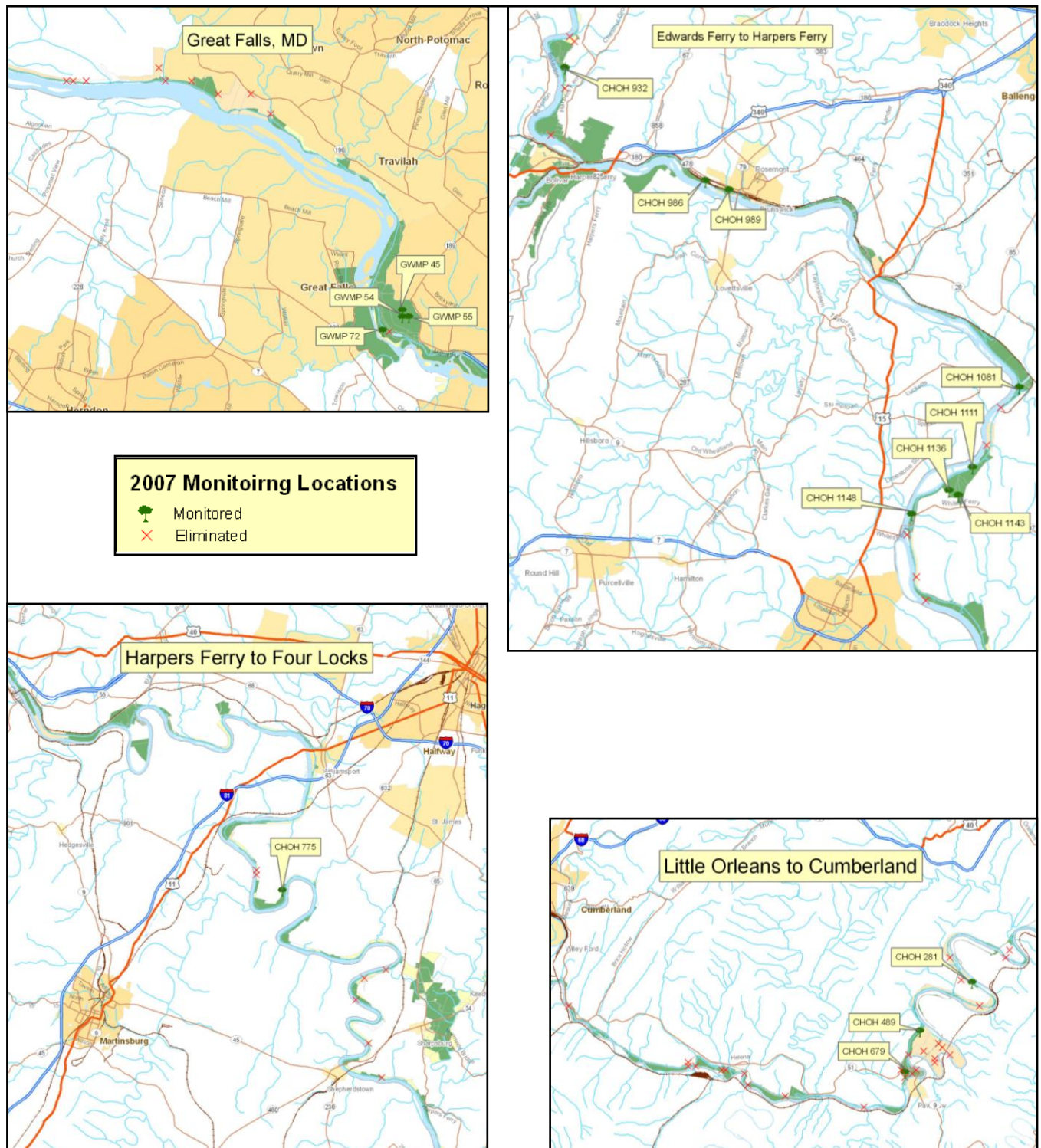


Figure 4. Locations considered for forest monitoring along the C&O Canal.

Table 32. Density, basal area (BA) and richness of trees, saplings and seedlings on the C&O Canal.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ ha	Species
CHOH-0281	33	467	236,000	9	15	1770	43,400	4	2	1670	2
CHOH-0489	45	637	270,000	5	5	589	7700	3	3	2500	3
CHOH-0679	9	127	68,800	2	6	707	27,300	2	2	1670	1
CHOH-0775	19	269	94,800	4	4	472	7050	1	13	10,800	2
CHOH-0932	30	424	193,000	13	12	1420	22,000	6	3	2500	2
CHOH-0986	30	424	425,000	8	-	-	-	-	2	1670	2
CHOH-0989	38	538	243,000	2	6	707	15,300	2	2	1670	2
CHOH-1081	22	311	384,000	4	1	118	118	1	1	833	1
CHOH-1111	29	410	252,000	10	4	472	10,500	4	10	8330	3
CHOH-1136	33	467	254,000	10	6	707	7480	4	-	-	-
CHOH-1143	29	410	348,000	6	6	707	10,300	3	1	833	1
CHOH-1148	16	226	39,200	3	53	6250	106,000	3	1	833	1
GWMP-0045	20	283	459,000	9	5	589	15,700	2	3	2500	1
GWMP-0054	26	368	288,000	5	6	707	11,500	2	-	-	-
GWMP-0055	22	311	335,000	6	1	118	1270	1	-	-	-
GWMP-0072	29	410	160,000	8	9	1060	28,100	6	-	-	-
Total	430	380	253,000	39	139	1020	19,600	24	43	2190	14

Forty five different tree species are found on the C&O Canal (Table 32).

Table 33. Tree species found along the C&O Canal.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	82	29,300	54/12	40	4282	9
<i>Acer rubrum</i>	red maple	30	5890	-	7	781	2
<i>Acer saccharinum</i>	silver maple	26	22,700	11/2	13	2540	-
¹ <i>Ailanthus altissima</i>	tree of heaven	3	839	2/-	-	-	-
<i>Amelanchier arborea</i>	common serviceberry	2	266	1/-	-	-	-
<i>Aralia spinosa</i>	devil's walkingstick	-	-	-	2	464	-
<i>Asimina triloba</i>	pawpaw	-	-	-	13	693	18
<i>Carya alba</i>	mockernut	10	4420	1/-	1	37	-
<i>Carya cordiformis</i>	hickory	3	903	-	1	74	1
<i>Carya glabra</i>	bitternut hickory	16	4990	1/1	4	825	1
<i>Carya ovalis</i>	pignut hickory	1	198	-	1	66	-
<i>Celtis occidentalis</i>	red hickory	5	833	-	1	449	3
<i>Cercis canadensis</i>	common hackberry	-	-	-	1	22	-
<i>Chionanthus virginicus</i>	eastern redbud	-	-	-	1	199	-
<i>Cornus florida</i>	white fringetree	2	173	-	7	1490	-
<i>Crataegus crus-galli</i>	flowering dogwood	1	84	1/-	5	1520	-
<i>Diospyros virginiana</i>	cockspur hawthorn	2	429	2/1	-	-	-
<i>Fagus grandifolia</i>	common persimmon	7	1450	1/-	7	449	-
<i>Fraxinus americana</i>	American beech	15	8640	5/1	12	1750	1
<i>Fraxinus pennsylvanica</i>	white ash	2	3760	2/-	-	-	1
<i>Juglans nigra</i>	green ash	3	1250	-	-	-	-
<i>Juniperus virginiana</i>	black walnut	5	893	-	-	-	-
<i>Liriodendron tulipifera</i>	eastern redcedar	23	28,900	1/-	2	648	-
¹ <i>Maclura pomifera</i>	tuliptree	4	1300	4/3	-	-	-
<i>Nyssa sylvatica</i>	Osage orange	8	1100	-	9	1220	-
<i>Ostrya virginiana</i>	blackgum	-	-	-	3	354	-
<i>Pinus pungens</i>	hophornbeam	1	841	-	-	-	-
<i>Pinus strobus</i>	Table Mountain pine	4	2060	-	1	125	-
<i>Pinus virginiana</i>	eastern white pine	46	20,100	6/-	-	-	-
<i>Platanus occidentalis</i>	Virginia pine	12	16,000	10/1	-	-	-
¹ <i>Prunus avium</i>	American sycamore	1	220	-	-	-	1

Table 34. Tree species found along the C&O Canal (continued).

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Prunus serotina</i>	black cherry	7	3830	5/4	-	-	-
<i>Quercus alba</i>	white oak	13	19,300	-	-	-	-
<i>Quercus coccinea</i>	scarlet oak	9	14,500	-	-	-	1
<i>Quercus falcata</i>	southern red oak	1	2230	-	-	-	-
<i>Quercus ilicifolia</i>	bear oak	-	-	-	2	88	1
<i>Quercus prinus</i>	chestnut oak	40	24,300	-	2	273	1
<i>Quercus rubra</i>	northern red oak	17	10,400	-	2	580	-
<i>Quercus shumardii</i>	Shumard's oak	1	1910	1/-	-	-	-
<i>Quercus stellata</i>	post oak	2	1800	-	-	-	-
<i>Quercus velutina</i>	black oak	6	7870	-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	2	2130	1/-	-	-	-
<i>Sassafras albidum</i>	sassafras	5	662	2/1	-	-	-
<i>Ulmus americana</i>	American elm	11	6080	4/-	2	693	2
<i>Ulmus rubra</i>	slippery elm	2	519	-	-	-	1

¹Non-native species.

Shrubs were found at only five plots at scattered locations along the canal (Table 33).

Table 35. Density, basal area, seedling density and species richness of shrubs along the C&O Canal.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedling/ha
CHOH-0281	2	236	1	46,100	10	8330
CHOH-0489	-	-	-	-	-	-
CHOH-0679	-	-	-	-	-	-
CHOH-0775	-	-	-	-	-	-
CHOH-0932	-	-	-	-	-	-
CHOH-0986	24	2830	1	117,000	2	1670
CHOH-0989	6	707	1	48,300	7	5830
CHOH-1081	10	1180	1	74,500	6	5000
CHOH-1111	2	236	1	14,200	2	1670
CHOH-1136	-	-	-	-	-	-
CHOH-1143	-	-	-	-	-	-
CHOH-1148	-	-	-	-	-	-
GWMP-0045	-	-	-	-	-	-
GWMP-0054	-	-	-	-	-	-
GWMP-0055	-	-	-	-	-	-
GWMP-0072	-	-	-	-	-	-
Total	44	324	1	18,700	27	1410

Northern spicebush (*Lindera benzoin*) was the only species found along the canal (Table 34).

Table 36. Shrub species found along the C&O Canal.

Latin Name	Common Name	Shrubs	Seedlings
<i>Lindera benzoin</i>	northern spicebush	44	27

Forest Pests and Diseases

No pests or diseases were found in 2007.

Exotic Plant Species

Exotic Trees

Three exotic tree species are found on the canal (Table 32). They make up 1.8% of all individuals and 0.9% of all basal area in the tree layer, are absent from the sapling layer, and are 2.3% of all seedlings.

Vines in Trees

Vines in trees are common along the C&O Canal (Table 35). Vines were especially common on plot CHOH-0775 near the midpoint of the canal. On the other hand, no vines were found on trees in the Potomac Gorge between Swains lock and Georgetown.

Table 37. Presence of vines on the C&O Canal.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CHOH-0281	33	25	5
CHOH-0489	45	-	-
CHOH-0679	9	4	1
CHOH-0775	19	20	16
CHOH-0932	30	8	1
CHOH-0986	30	19	-
CHOH-0989	38	28	-
CHOH-1081	22	12	5
CHOH-1111	29	1	-
CHOH-1136	33	-	-
CHOH-1143	29	-	-
CHOH-1148	16	2	-
GWMP-0045	20	-	-
GWMP-0054	26	-	-
GWMP-0055	22	-	-
GWMP-0072	29	-	-
Total	430	119	28

Most vines growing in trees on the Canal are native species (Table 36). However, numerous exotic vines, such as winter creeper (*Euonymus fortunei*) and Japanese honeysuckle (*Lonicera japonica*) were also found.

Table 38. Species of vines in trees on the C&O Canal.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Euonymus fortunei</i>	winter creeper	21	-
¹ <i>Hedera helix</i>	English ivy	2	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	14	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	64	7
¹ <i>Rosa multiflora</i>	multiflora rose	3	-
<i>Smilax</i> spp.	greenbrier	2	1
<i>Toxicodendron radicans</i>	eastern poison ivy	6	1
<i>Vitis</i> spp.	grape	30	21

¹ Non-native species.

Exotic Shrubs

No exotic shrubs were monitored in 2007.

Exotic Herbaceous Plants

Exotic herbaceous plants are very common on the C&O Canal. All but five plots, and 50% of all quadrats monitored, had exotic plants growing on them (Table 37).

Table 39. Presence of exotic herbaceous plants on the C&O Canal.

Plot	Quadrats with Exotics	Number of Exotic Species
CHOH-0281	12	5
CHOH-0489	-	-
CHOH-0679	12	4
CHOH-0775	12	4
CHOH-0932	5	2
CHOH-0986	12	4
CHOH-0989	12	4
CHOH-1081	6	2
CHOH-1111	11	2
CHOH-1136	-	-
CHOH-1143	-	-
CHOH-1148	11	5
GWMP-0045	2	1
GWMP-0054	-	-
GWMP-0055	-	-
GWMP-0072	2	2
Total	97	9

Nine species of exotic herbaceous plants were found on the canal (Table 38).

Table 40. Cover of exotic plants on the C&O Canal.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	8	9%
<i>Berberis thunbergii</i>	Japanese barberry	2	3%
<i>Duchesnea indica</i>	Indian strawberry	4	6%
<i>Euonymus fortunei</i>	winter creeper	2	7%
<i>Glechoma hederacea</i>	ground ivy	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	9	3%
<i>Microstegium vimineum</i>	Japanese stiltgrass	6	8%
<i>Rosa multiflora</i>	multiflora rose	2	4%
<i>Rubus phoenicolasius</i>	Wine raspberry	1	<1%

George Washington Memorial Parkway

Eight plots were monitored along the George Washington Memorial Parkway (GWMP) in 2007. Three plots are on Daingerfield Island, and five are in Great Falls Park (Figure 5).

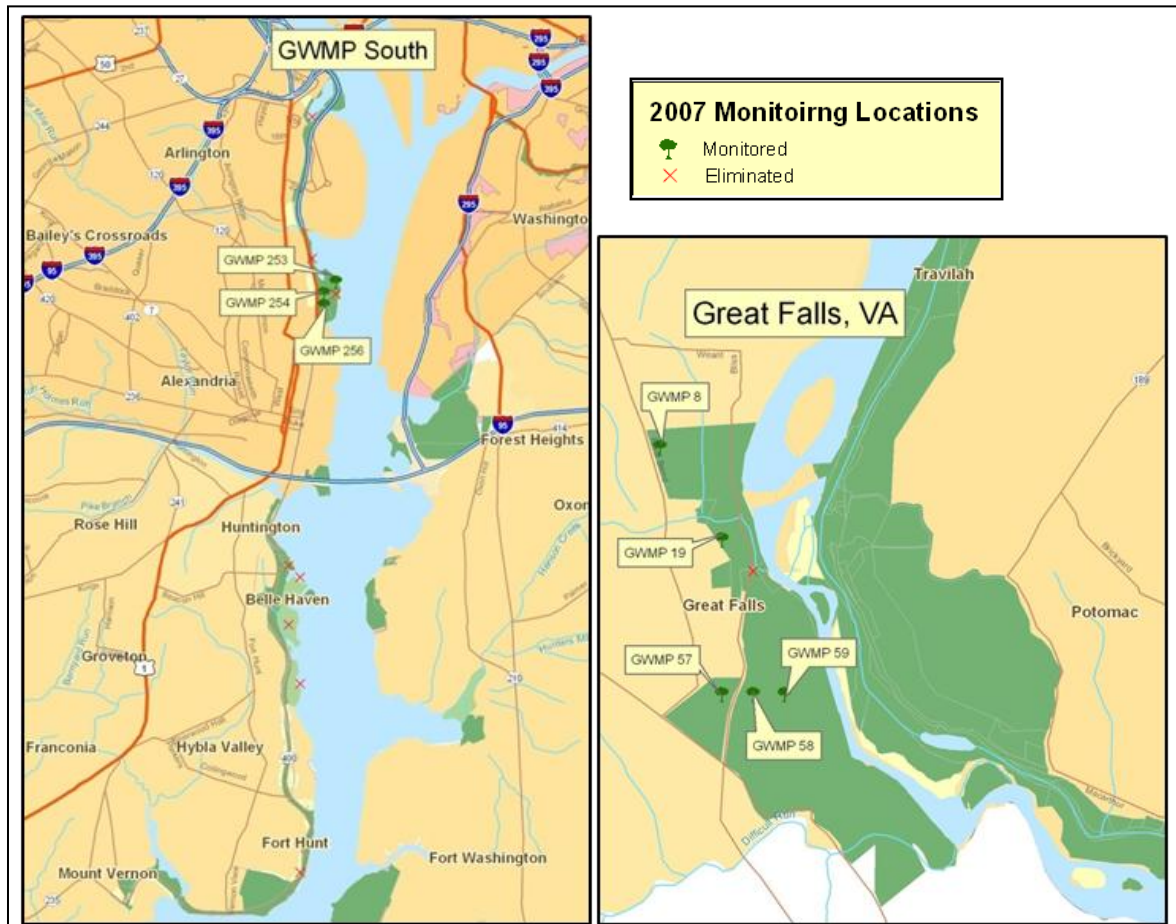


Figure 5. Locations considered for forest monitoring in George Washington Memorial Parkway.

Forest Communities

Density and basal area information for the eight plots is presented in Table 39. In total, 25 tree species were found (Table 40).

Table 41. Density, basal area (BA) and richness of trees, saplings and seedlings in GWMP.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
GWMP-0008	11	156	491,000	4	13	1530	7140	1	3	2500	1
GWMP-0019	19	269	304,000	10	9	1060	5790	6	27	22,500	3
GWMP-0057	23	325	231,000	9	10	1180	24,700	4	-	-	-
GWMP-0058	25	354	227,000	8	8	943	26,000	3	2	1670	1
GWMP-0059	33	467	574,000	3	2	236	3320	2	-	-	-
GWMP-0253	32	453	248,000	7	2	236	1230	1	-	-	-
GWMP-0254	15	212	247,000	5	-	-	-	-	4	3330	3
GWMP-0256	18	255	182,000	6	5	589	15,700	3	2	1670	2
Total	176	311	313,000	25	49	722	10,500	18	38	3960	7

Table 42. Tree species found in GWMP.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	10	3480	1/-	2	133	1
<i>Acer saccharinum</i>	silver maple	8	9920	8/2	-	-	-
¹ <i>Ailanthus altissima</i>	tree of heaven	1	1480	1/1	-	-	-
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	1	15	-
<i>Asimina triloba</i>	pawpaw	-	-	-	17	1080	30
<i>Carya alba</i>	mockernut	6	1860	-	1	44	-
	hickory						
<i>Carya glabra</i>	pignut hickory	4	1250	-	3	1280	-
<i>Celtis occidentalis</i>	common hackberry	1	292	1/-	1	103	-
<i>Cornus amomum</i>	silky dogwood	-	-	-	-	-	1
<i>Cornus florida</i>	flowering dogwood	-	-	-	3	516	-
<i>Fagus grandifolia</i>	American beech	3	813	-	1	324	1
<i>Fraxinus pennsylvanica</i>	green ash	6	5740	6/1	-	-	-
<i>Ilex opaca</i>	American holly	4	663	-	5	1660	-
<i>Liriodendron tulipifera</i>	tulip poplar	49	163,000	6/-	1	383	-
¹ <i>Magnolia grandifolia</i>	southern magnolia	7	12,600	7/1	-	-	1
¹ <i>Morus alba</i>	white mulberry	8	7930	8/5	-	-	-
<i>Nyssa sylvatica</i>	blackgum	9	3040	-	9	3020	-
<i>Platanus occidentalis</i>	American sycamore	1	3340	-	-	-	-
<i>Populus deltoides</i>	eastern cottonwood	3	11,800	3/1	-	-	-
<i>Prunus serotina</i>	black cherry	8	10,700	8/2	-	-	-
<i>Quercus alba</i>	white oak	5	3420	-	-	-	-
<i>Quercus coccinea</i>	scarlet oak	1	4340	-	-	-	-
<i>Quercus falcata</i>	southern red oak	1	1060	-	-	-	-
<i>Quercus palustris</i>	pin oak	-	-	-	-	-	3
<i>Quercus phellos</i>	willow oak	2	15,600	2/1	-	-	-
<i>Quercus prinus</i>	chestnut oak	7	8490	-	-	-	-
<i>Quercus rubra</i>	northern red oak	3	14,500	-	-	-	-

Table 43. Tree species found in GWMP (continued).

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Quercus velutina</i>	black oak	9	19,100	-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	3	1230	3/2	-	-	-
<i>Sassafras albidum</i>	sassafras	-	-	-	1	368	-
¹ <i>Sophara japonica</i>	Japanese pagoda tree	-	-	-	-	-	1
<i>Ulmus americana</i>	American elm	17	7050	17/3	4	1580	-

¹Non-native species.

Shrubs were found in four of the GWMP plots monitored in 2007 (Table 41).

Table 44. Density, basal area, seedling density and species richness of shrubs in GWMP.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
GWMP-0008	54	6370	1	133,000	55	45,800
GWMP-0019	16	1890	1	60,500	-	-
GWMP-0057	-	-	-	-	-	-
GWMP-0058	-	-	-	-	-	-
GWMP-0059	5	589	2	10,100	-	-
GWMP-0253	5	589	1	30,000	-	-
GWMP-0254	-	-	-	-	1	833
GWMP-0256	-	-	-	-	-	-
Total	80	1180	4	29,100	56	5830

Only four shrub species were found (Table 42), the most common of which was northern spicebush (*Lindera benzoin*)

Table 45. Shrub species found in GWMP.

Latin Name	Common Name	Shrubs	Seedlings
<i>Kalmia latifolia</i>	mountain laurel	16	-
<i>Lindera benzoin</i>	northern spicebush	55	55
¹ <i>Lonicera maackii</i>	Amur honeysuckle	5	-
<i>Viburnum prunifolium</i>	blackhaw	4	1

¹Non-native species.

Forest Pests and Diseases.

One silver maple (*Acer saccharinum*) tree was infested with gypsy moth. This tree was located in plot GWMP-253 on Daingerfield Island.

Exotic Plant Species

Exotic Trees

Four exotic tree species were found (Table 40). They make up 9.1% of all individuals and 7.0% of all basal area in the tree layer, are absent from the sapling layer, and are 5.2% of all seedlings.

Vines in Trees

Vines in trees are common in the plots on Daingerfield Island (Table 43).

Table 46. Presence of vines in GWMP.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
GWMP-0008	11	-	-
GWMP-0019	19	-	-
GWMP-0057	23	-	-
GWMP-0058	25	-	-
GWMP-0059	33	6	-
GWMP-0253	32	32	6
GWMP-0254	15	15	4
GWMP-0256	18	18	9
Total	176	71	19

The exotic vine English ivy (*Hedera helix*) was the most common species (Table 44). Exotic vines outnumbered native vines, both in terms of species richness and in number of trees with vines.

Table 47. Species of vines in trees in GWMP.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	Amur peppervine	4	4
<i>Campsis radicans</i>	trumpet creeper	2	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	6	3
¹ <i>Euonymus fortunei</i>	winter creeper	3	2
¹ <i>Hedera helix</i>	English ivy	56	16
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	25	10
¹ <i>Lonicera</i> spp.	honeysuckle	1	-
<i>Parthenocissus quinquefolia</i>	Virginia creeper	24	9
¹ <i>Rosa multiflora</i>	multiflora rose	2	1
<i>Smilax</i> spp.	greenbrier	1	-
<i>Toxicodendron radicans</i>	eastern poison ivy	34	4
<i>Vitis</i> spp.	grape	15	11
¹ <i>Wisteria sinensis</i>	Chinese wisteria	19	4

¹ Non-native species.

Exotic Shrubs

The only exotic shrub species found was Amur honeysuckle (*Lonicera maackii*). Five individuals were found on plot GWMP-253 on Daingerfield Island.

Exotic Herbaceous Species

Exotic herbaceous plants are found on all quadrats on Daingerfield Island and occasionally in Great Falls, VA (Table 45).

Table 48. Presence of exotic herbaceous plants in GWMP.

Plot	Quadrats with Exotics	Number of Exotic Species
GWMP-0008	9	3
GWMP-0019	1	1
GWMP-0057	-	-
GWMP-0058	-	-
GWMP-0059	12	2
GWMP-0253	12	6
GWMP-0254	12	5
GWMP-0256	12	4
Total	58	11

English ivy (*Hedera helix*) and Japanese stiltgrass (*Microstegium vimineum*) had the highest % cover, whereas Japanese honeysuckle (*Lonicera japonica*) was found in the most plots (Table 46).

Table 49. Cover of exotic plants in GWMP.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	1	<1%
<i>Ampelopsis brevipedunculata</i>	Amur peppervine	2	24%
<i>Berberis thunbergii</i>	Japanese barberry	1	4%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	5%
<i>Euonymus fortunei</i>	winter creeper	1	2%
<i>Glechoma hederacea</i>	ground ivy	1	<1%
<i>Hedera helix</i>	English ivy	3	30%
<i>Lonicera japonica</i>	Japanese honeysuckle	5	7%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3	29%
<i>Rosa multiflora</i>	multiflora rose	2	4%
<i>Wisteria sinensis</i>	Chinese wisteria	1	14%

Harpers Ferry National Historical Park

Two plots were monitored in Harper's Ferry in 2007 (Figure 6).

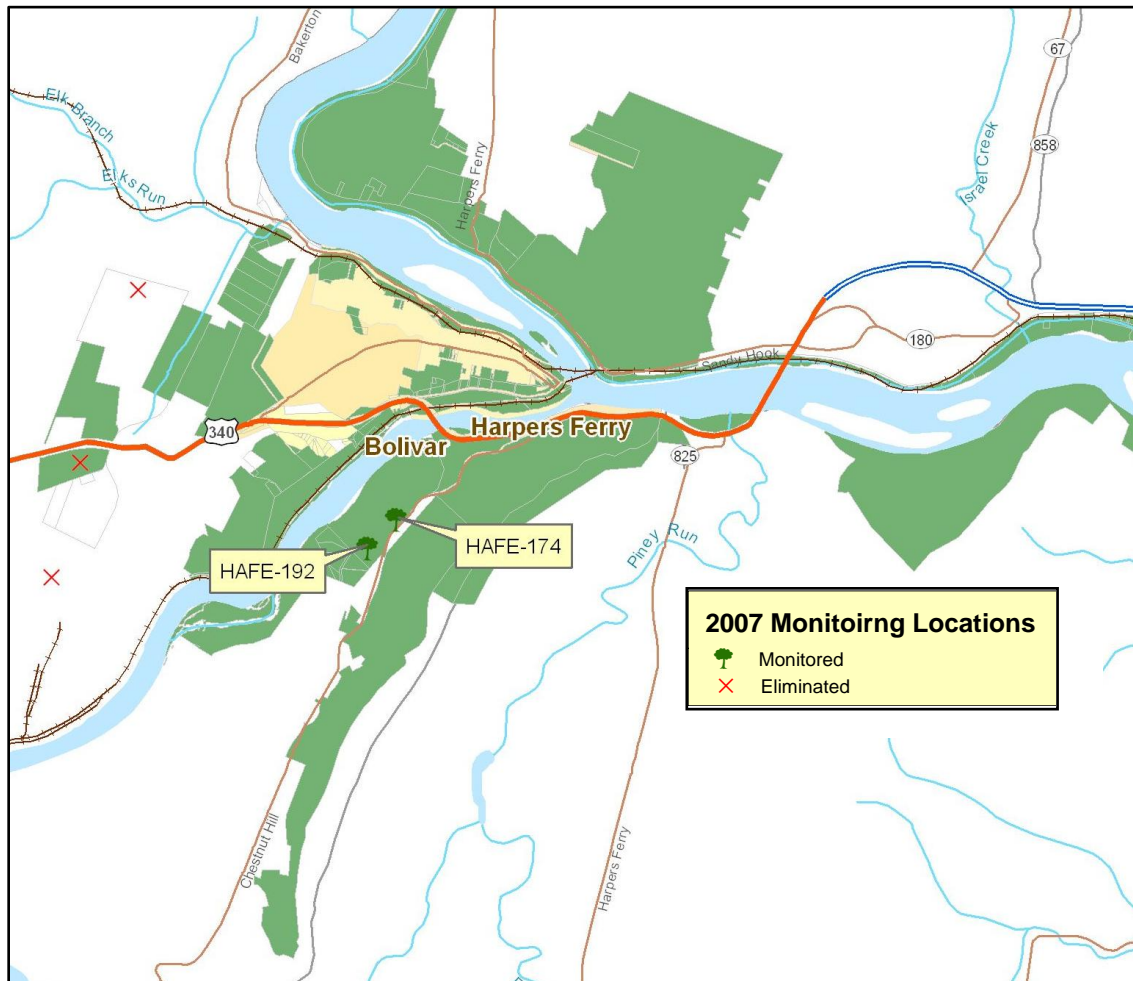


Figure 6. Locations considered for forest monitoring in Harpers Ferry.

Forest Communities

Density and basal area information for the two plots is presented in Table 47.

Table 50. Density, basal area (BA) and richness of trees, saplings and seedlings in Harpers Ferry.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
HAFE-0174	8	113	134,000	4	8	943	9930	4	26	21,700	5
HAFE-0192	28	396	254,000	6	7	825	15,300	4	4	3330	2
Total	36	255	194,000	7	15	884	12,600	6	30	12,500	6

In total, 14 tree species were found in the plots (Table 48).

Table 51. Tree species found in Harpers Ferry.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	-	-	-	-	-	1
<i>Acer rubrum</i>	red maple	17	47,000	1/-	2	2830	-
<i>Asimina triloba</i>	pawpaw	-	-	-	5	766	4
<i>Celtis occidentalis</i>	hackberry	-	-	-	-	-	1
<i>Cercis canadensis</i>	eastern redbud	-	-	-	2	2480	-
<i>Cornus florida</i>	flowering dogwood	-	-	-	1	295	-
<i>Fraxinus americana</i>	white ash	6	23,100	-	4	6190	21
<i>Juglans nigra</i>	black walnut	-	-	-	-	-	1
<i>Liriodendron tulipifera</i>	tulip poplar	4	75,100	1/-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	2	4560	1/-	-	-	-
<i>Prunus serotina</i>	black cherry	4	34,000	-	1	59	-
¹ <i>Pyrus communis</i>	common pear	1	764	-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	2	9510	-	-	-	-
<i>Ulmus americana</i>	American elm	-	-	-	-	-	2

¹Non-native species.

Shrubs were common in both of the plots (Table 49).

Table 52. Density, basal area, seedling density and species richness of shrubs in Harper's Ferry.

Plot	Shrubs	Shrubs / ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
HAFE-0174	15	1770	1	92,300	35	29,200
HAFE-0192	28	3300	1	96,600	37	30,800
Total	43	2540	1	94,500	72	30,000

Northern spicebush (*Lindera benzoin*) was the only shrub species found (Table 50).

Table 53. Shrub species found in Harpers Ferry.

Latin Name	Common Name	Shrubs	Seedlings
<i>Lindera benzoin</i>	northern spicebush	43	72

Forest Pests and Diseases

No forest pests or disease were monitored in Harpers Ferry in 2007.

Exotic Plant Species

Exotic Trees

Two exotic tree species were found (Table 48). They make up 8.3% of all individuals and 2.7% of all basal area in the tree layer, and are absent from the sapling and seedling layers.

Vines on Trees

Few vines were found growing on trees (Table 51).

Table 54. Presence of vines in Harpers Ferry.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
HAFE-0174	8	1	-
HAFE-0192	28	2	-
Total	36	3	-

All vines monitored in Harpers Ferry were native (Table 52).

Table 55. Species of vines in trees in Harpers Ferry.

Latin Name	Common Name	Trees with Vines	Tree with Vines in Crown
<i>Smilax</i> spp.	greenbrier	2	-
<i>Toxicodendron radicans</i>	eastern poison ivy	2	-

Exotic Shrubs

All shrubs found in the monitoring plots are native (Table 50).

Exotic Herbaceous Plants

Exotic herbaceous species were found on both plots in Harpers Ferry (Table 53).

Table 56. Presence of exotic herbaceous plants in Harpers Ferry.

Plot	Quadrats with Exotics	Number of Exotic Species
HAFE-0174	12	4
HAFE-0192	7	3
Total	19	6

Six species of exotic herbaceous species were found in the park (Table 54). Only common periwinkle (*Vinca minor*) had a high % cover where it was found.

Table 57. Cover of exotic plants in Harpers Ferry.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	1%
<i>Lonicera japonica</i>	Japanese honeysuckle	2	1%
<i>Rosa multiflora</i>	multiflora rose	1	3%
<i>Rubus phoenicolasius</i>	wine raspberry	1	7%
<i>Vinca minor</i>	common periwinkle	1	56%

Manassas National Battlefield Park

Six forest vegetation plots were monitored in Manassas in 2007 (Figure 7).

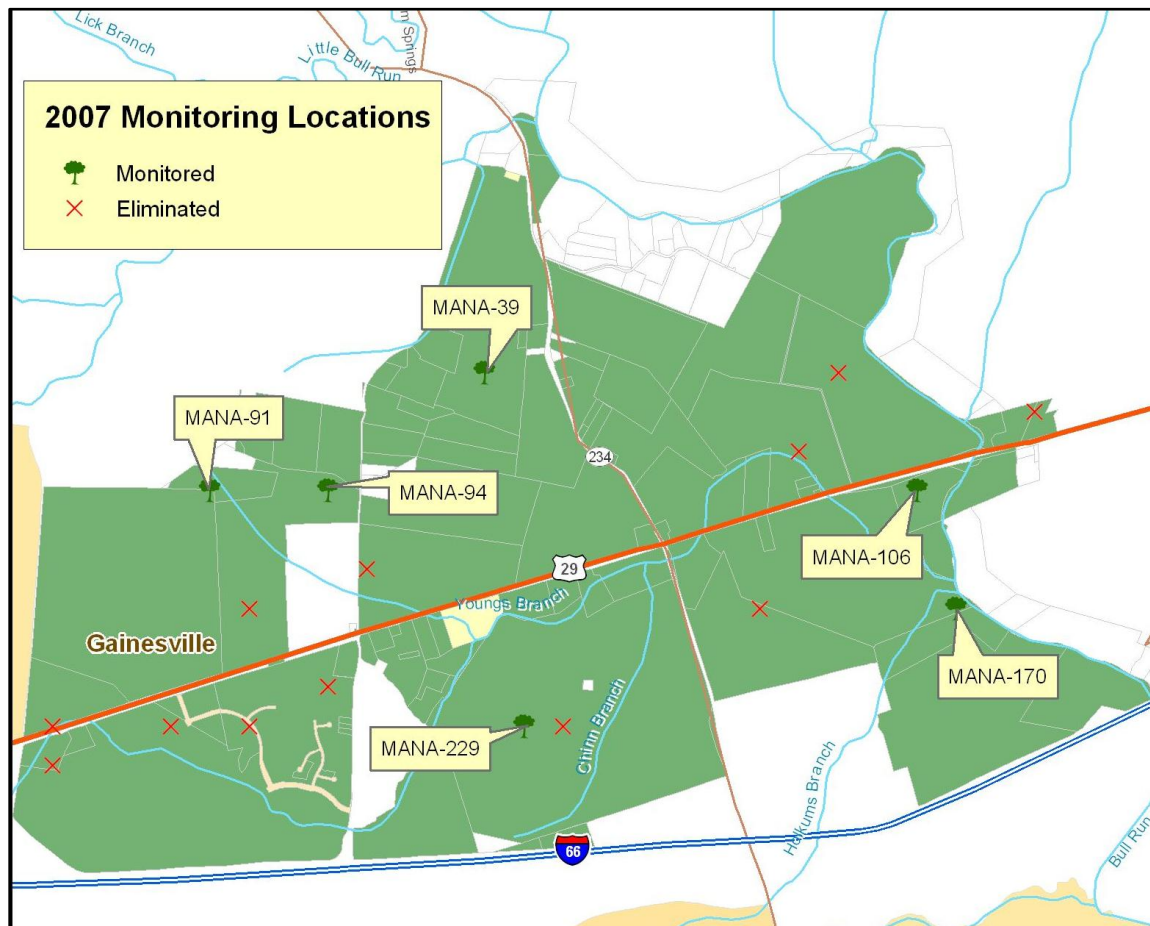


Figure 7. Locations considered for forest monitoring in Manassas.

Forest Communities

There is a high tree density on many of the plots in Manassas (Table 55). All plots have saplings on them, unlike many other locations in the NCRN. Twenty eight tree species were found on the plots (Table 56).

Table 58. Density, basal area (BA) and richness of trees, saplings and seedlings in Manassas.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
MANA-0039	45	637	246,000	6	3	354	12,800	3	-	-	-
MANA-0091	27	382	186,000	8	3	354	4070	1	23	19,200	7
MANA-0094	18	255	107,000	8	12	1420	22,800	6	10	8330	7
MANA-0106	28	396	199,000	7	3	354	15,000	2	-	-	-
MANA-0170	89	1260	373,000	7	3	354	17,500	2	-	-	-
MANA-0229	29	410	541,000	7	8	943	34,800	4	-	-	-
Total	236	556	275,000	24	32	629	17,800	12	33	4580	11

Table 59. Tree species found on the forest monitoring plots in Manassas.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in canopy	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	2	1410	-	-	-	-
<i>Acer rubrum</i>	red maple	9	11,800	2/-	2	1160	-
<i>Carpinus caroliniana</i>	American hornbeam	4	2030	2/1	-	-	-
<i>Carya alba</i>	mockernut	17	14,800	-	-	-	4
	hickory						
<i>Carya glabra</i>	pignut hickory	5	9840	-	-	-	2
<i>Carya ovalis</i>	red hickory	1	2510	-	-	-	-
<i>Celtis occidentalis</i>	common hackberry	1	207	-	-	-	-
<i>Cercis canadensis</i>	eastern redbud	1	255	-	4	1400	5
<i>Cornus florida</i>	flowering dogwood	-	-	-	1	177	1
<i>Diospyros virginiana</i>	common persimmon	-	-	-	1	98	-
<i>Fraxinus americana</i>	white ash	44	36,100	15/5	7	2540	11
<i>Fraxinus pennsylvanica</i>	green ash	12	18,410	6/-	2	1490	-
<i>Ilex opaca</i>	American holly	1	196	1/1	-	-	1
<i>Juglans nigra</i>	black walnut	3	5900	-	-	-	-
<i>Juniperus virginiana</i>	eastern redcedar	82	54,500	35/29	3	3480	-
<i>Liriodendron tulipifera</i>	tuliptree	1	566	1/-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	17	21,700	14/6	-	-	-
<i>Platanus occidentalis</i>	American sycamore	1	332	-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	-	-	-	2	1650	1
<i>Prunus serotina</i>	black cherry	1	193	-	3	1140	1
<i>Quercus alba</i>	white oak	12	54,300	-	-	-	3
<i>Quercus bicolor</i>	swamp white oak	1	229	1/-	-	-	-
<i>Quercus palustris</i>	pin oak	3	8280	1/1	1	138	-
<i>Quercus rubra</i>	northern red oak	1	11,600	-	-	-	-
<i>Quercus velutina</i>	black oak	1	8870	-	1	157	3
<i>Quercus</i> spp.	oak	-	-	-	-	-	1
<i>Ulmus americana</i>	American elm	13	10,300	5/2	-	-	-
<i>Ulmus rubra</i>	slippery elm	3	960	-	5	4400	-

¹Non-native species

Only 2 individual shrubs and 2 seedlings were monitored in Manassas (Table 57).

Table 60. Density, basal area, seedling density and species richness of shrubs in Manassas.

Plot	Shrubs	Shrubs/ ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
MANA-0039	-	-	-	-	-	-
MANA-0091	1	118	1	4030	2	1670
MANA-0094	1	118	1	2810	-	-
MANA-0106	-	-	-	-	-	-
MANA-0170	-	-	-	-	-	-
MANA-0229	-	-	-	-	-	-
Total	2	39	2	1140	2	277

Two shrub species were encountered (Table 58).

Table 61. Shrub species found in Manassas.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Ligustrum</i> spp.	privet	1	-
<i>Viburnum</i> <i>prunifolium</i>	Blackhaw	1	2

¹Non-native species.

Forest Pest and Diseases

None of the targeted forest pest or diseases were encountered in Manassas.

Exotic Plant Species

Exotic Trees

The only exotic trees found in Manassas were two saplings and one seedling of sweet cherry (*Prunus avium* [Table 57]). They were found on plot MANA-0094 in the northwestern portion of the park.

Vines on Trees

Vines were common in Manassas, particularly in plot MANA-0170 in the southwestern part of the park near Bull Run (Table 59).

Table 62. Presence of vines in Manassas.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
MANA-0039	45	16	5
MANA-0091	27	7	2
MANA-0094	18	16	8
MANA-0106	28	10	1
MANA-0170	89	34	29
MANA-0229	29	-	-
Total	236	83	45

Most vines in Manassas are native, but Japanese honeysuckle (*Lonicera japonica*) is also common (Table 60).

Table 63. Species of vines in trees in Manassas.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	21	10
<i>Parthenocissus quinquefolia</i>	Virginia creeper	13	5
¹ <i>Rosa multiflora</i>	multiflora rose	3	1
<i>Smilax</i> spp.	greenbrier	1	-
<i>Toxicodendron radicans</i>	eastern poison ivy	27	8
<i>Vitis</i> spp.	grape	39	31

¹ Non-native species.

Exotic Shrubs

A single privet (*Ligustrum* spp.) was the only exotic shrub found in Manassas (Table 58). It was found on MANA-94.

Exotic Herbaceous Plants

Exotics were found in all plots in Manassas, and were found in 68% of all quadrats (Table 61).

Table 64. Frequency of exotic herbaceous plants in Manassas.

Park	Quadrats with exotics	Number of exotic species
MANA-0039	7	1
MANA-0091	12	2
MANA-0094	12	4
MANA-0106	2	1
MANA-0170	12	3
MANA-0229	4	1
Total	49	5

None of the six herbaceous exotic species found has a high percent cover (Table 62).

Table 65. Cover of herbaceous exotic plants in Manassas.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	1	9%
<i>Ampelopsis brevipedunculata</i>	Amur peppervine	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	4	4%
<i>Lonicera</i> spp.	honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	4	11%
<i>Rosa multiflora</i>	multiflora rose	1	3%

National Capital Parks East

Thirteen plots were monitored in NACE in 2007 (Figure 8). These included four plots in Piscataway, three plots in Greenbelt, and one plot each in the Baltimore-Washington Parkway, Fort Circle Trail, Fort Dupont, Fort Greble, the Suitland Parkway and Fort Washington.

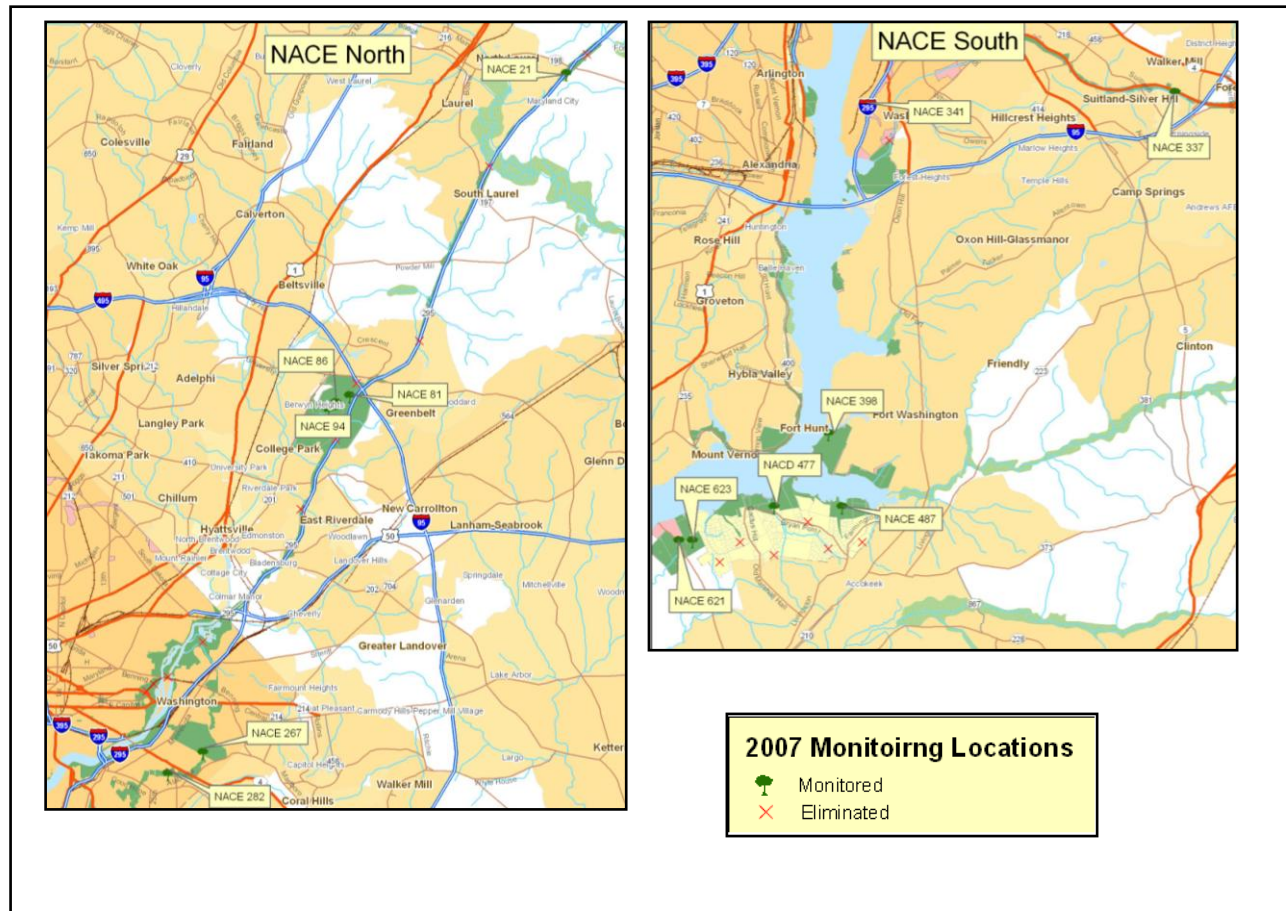


Figure 8. Locations considered for monitoring in National Capital Parks East.

Forest Communities

Tree density and basal area for NACE are presented in Table 63.

Table 66. Density, basal area (BA) and richness of trees, saplings and seedlings in NACE.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
NACE-0021	49	693	329,000	9	10	1180	20,500	3	10	8330	4
NACE-0081	31	439	237,000	9	2	236	9210	2	28	23,300	6
NACE-0086	36	509	271,000	9	3	354	8560	3	-	-	-
NACE-0094	27	382	501,000	8	4	472	6680	2	33	27,500	1
NACE-0267	13	184	289,000	8	1	118	837	1	2	1670	2
NACE-0282	21	297	308,000	4	3	354	12,400	2	45	37,500	5
NACE-0337	16	226	483,000	4	4	472	14,000	3	1	833	1
NACE-0341	28	396	364,000	6	-	-	-	-	1	833	1
NACE-0398	25	354	337,000	7	10	1180	30,800	2	10	8330	2
NACE-0477	47	665	509,000	3	3	354	4340	1	1	833	1
NACE-0487	58	821	434,000	7	9	1060	21,900	2	-	-	-
NACE-0621	36	509	276,000	10	10	1180	22,600	4	9	7500	3
NACE-0623	27	382	196,000	7	28	3300	42,600	6	14	11,700	5
Total	414	451	349,000	35	87	789	14,900	16	154	9870	16

Overall, 36 tree species were found on the ten plots in NACE (Table 64).

Table 67. Tree species found on the forest monitoring plots in NACE.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	4	1570	-	-	-	2
<i>Acer rubrum</i>	red maple	78	37,100	15/2	11	2060	2
<i>Acer saccharinum</i>	silver maple	2	6660	2/2	-	-	1
¹ <i>Ailanthus altissima</i>	tree of heaven	3	1060	2/1	-	-	-
<i>Asimina triloba</i>	pawpaw	4	408	2/2	9	2130	15
<i>Carya alba</i>	mockernut	-	-	-	1	18	-
	hickory						
<i>Carya cordiformis</i>	bitternut hickory	2	323	2/1	1	63	-
<i>Cornus florida</i>	flowering dogwood	3	624	-	-	-	-
<i>Diospyros virginiana</i>	common persimmon	1	731	1/-	-	-	-
<i>Fagus grandifolia</i>	American beech	10	1950	3/1	7	1240	-
<i>Fraxinus americana</i>	white ash	9	5940	7/1	-	-	-
<i>Fraxinus pennsylvanica</i>	green ash	43	38,500	23/1	3	336	1
<i>Ilex opaca</i>	American holly	19	3520	6/-	10	1370	7
<i>Liquidambar styraciflua</i>	sweetgum	47	42,300	20/1	23	3710	63
<i>Liriodendron tulipifera</i>	tulip poplar	12	64,900	4/-	-	-	2
¹ <i>Morus alba</i>	white mulberry	1	212	1/-	-	-	-
<i>Morus rubra</i>	red mulberry	1	233	1/1	-	-	-
<i>Nyssa sylvatica</i>	blackgum	32	10,500	2/1	9	1490	4
<i>Pinus rigida</i>	pitch pine	3	2130	2/1	-	-	-
<i>Pinus virginiana</i>	Virginia pine	25	24,000	2/1	-	-	1
<i>Platanus occidentalis</i>	American sycamore	4	1460	-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	1	1870	1/-	-	-	-
<i>Prunus serotina</i>	black cherry	10	22,300	6/3	1	9	11
<i>Quercus alba</i>	white oak	13	9710	4/-	1	9	7
<i>Quercus coccinea</i>	scarlet oak	15	13,000	2/-	1	671	-
<i>Quercus falcata</i>	southern red oak	10	10,600	1/-	-	-	-
<i>Quercus muehlenbergii</i>	chinkapin oak	1	202	-	-	-	-
<i>Quercus palustris</i>	pin oak	3	4580	2/-	-	-	2
<i>Quercus phellos</i>	willow oak	3	4260	2/-	-	-	1
<i>Quercus prinus</i>	chestnut oak	14	18,900	-	-	-	34
<i>Quercus rubra</i>	northern red oak	1	147	-	1	127	-
<i>Quercus velutina</i>	black oak	2	534	-	-	-	-
<i>Robinia pseudo-acacia</i>	black locust	6	5420	6/3	-	-	-
<i>Sassafras albidum</i>	sassafras	18	5340	14/4	1	399	1
<i>Ulmus americana</i>	American elm	11	6820	5/-	7	1060	-
<i>Ulmus rubra</i>	slippery elm	3	1070	1/1	1	236	-

¹Non-native species.

The number and basal area of shrubs varied greatly across NACE (Table 65).

Table 68. Density, basal area, seedling density and species richness of shrubs in NACE.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
NACE-0021	-	-	-	-	14	11,700
NACE-0081	3	354	1	30,400	-	-
NACE-0086	3	354	2	11,500	9	7500
NACE-0094	-	-	-	-	-	-
NACE-0267	-	-	-	-	1	833
NACE-0282	17	2000	1	41,800	5	4170
NACE-0337	38	4480	1	212,000	48	40,000
NACE-0341	1	118	1	7500	-	-
NACE-0398	1	118	1	2810	6	5000
NACE-0477	22	2590	3	777,000	10	8330
NACE-0487	-	-	-	-	-	-
NACE-0621	2	236	2	5300	-	-
NACE-0623	7	825	2	128,000	-	-
Total	94	852	11	93,500	93	5960

Northern spicebush (*Lindera benzoin*) is the most common shrub in NACE (Table 66).

Table 69. Shrub species found on forest monitoring plots in NACE.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Elaeagnus umbellata</i>	autumn olive	1	-
<i>Gaylussacia frondosa</i>	blue huckleberry	-	6
<i>Ilex verticillata</i>	common winterberry	19	2
<i>Kalmia latifolia</i>	mountain laurel	22	1
<i>Lindera benzoin</i>	northern spicebush	41	48
<i>Rhododendron periclymenoides</i>	pink azalea	-	11
<i>Rubus argutus</i>	sawtooth blackberry	-	1
<i>Vaccinium corymbosum</i>	highbush blueberry	8	9
<i>Vaccinium fuscatum</i>	black highbush blueberry	1	-
<i>Viburnum dentatum</i>	southern arrowwood	2	14
<i>Viburnum prunifolium</i>	blackhaw	-	1

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found in NACE.

Exotic Plant Species

Exotic Trees

Three exotic tree species were found (Table 64). They make up 1.2% of all individuals and 0.9% of all basal area in the tree layer, are absent from the sapling and seedling layers.

Vines in Trees

Vines are very common on trees in NACE. Over 33% of all trees have vines in them, and over 6% have vines in their crowns (Table 67).

Table 70. Presence of vines in NACE.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
NACE-0021	49	18	4
NACE-0081	31	-	-
NACE-0086	36	-	-
NACE-0094	27	4	-
NACE-0267	13	13	7
NACE-0282	21	-	-
NACE-0337	16	14	-
NACE-0341	28	25	7
NACE-0398	25	10	5
NACE-0477	47	23	1
NACE-0487	58	13	-
NACE-0621	36	10	3
NACE-0623	27	9	-
Total	414	139	27

Eastern poison ivy (*Toxicodendron radicans*) was the most common vine in NACE (Table 68).

Table 71. Species of vines in trees in NACE.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Campsis radicans</i>	trumpet creeper	14	4
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	3	3
¹ <i>Hedera helix</i>	English ivy	5	1
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	14	7
<i>Parthenocissus quinquefolia</i>	Virginia creeper	38	7
<i>Smilax</i> spp.	greenbrier	39	8
<i>Toxicodendron radicans</i>	eastern poison ivy	71	10
<i>Vitis</i> spp.	grape	18	12

¹Non-native species

Exotic Shrubs

Only a single individual exotic shrub was found, an autumn olive (*Elaeagnus umbellata*).

Exotic Herbaceous Plants

Ten out of the thirteen ten plots in NACE had exotic herbaceous species (Table 69).

Table 72. Frequency of exotic herbaceous plants in NACE.

Park	Quadrats with exotics	Number of exotic species
NACE-0021	6	2
NACE-0081	-	-
NACE-0086	-	-
NACE-0094	12	3
NACE-0267	12	4
NACE-0282	4	1
NACE-0337	8	2
NACE-0341	2	1
NACE-0398	3	2
NACE-0477	9	1
NACE-0487	12	3
NACE-0621	4	3
NACE-0623	-	-
Total	72	9

Most exotics species had a fairly low percent cover, except for Japanese stiltgrass (*Microstegium vimineum* [Table 70]).

Table 73. Cover of herbaceous exotic plants in NACE.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	1	<1%
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Clematis orbiculatus</i>	Oriental bittersweet	3	2%
<i>Hedera helix</i>	English Ivy	2	4%
<i>Lonicera japonica</i>	Japanese honeysuckle	7	6%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3	31%
<i>Polygonum perfoliatum</i>	Asiatic tearthumb	1	<1%
<i>Rosa multiflora</i>	multiflora rose	3	1%
<i>Vinca minor</i>	common periwinkle	1	<1%

Prince William Forest Park

Thirty-three plots were monitored in Prince William in 2007. The plots were located throughout the park (Figure 9).

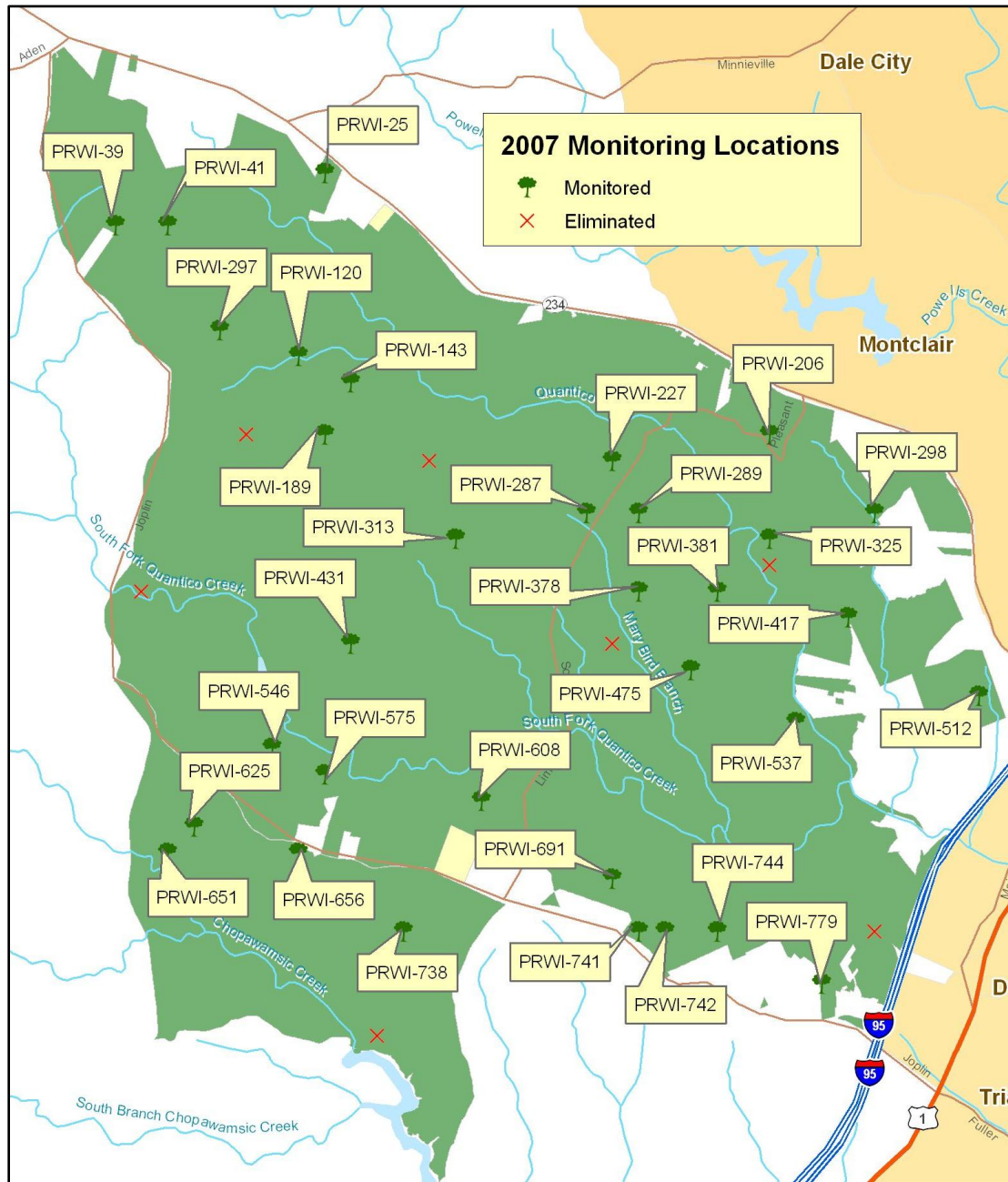


Figure 9. Locations considered for forest monitoring in Prince William.

Forest Communities

Sapling density and basal area was higher than the other parks in the region. Seedlings were found on almost every plot monitored (Table 71).

Table 74. Density, basal area (BA) and richness of trees, saplings, and seedlings in Prince William.

Plot	Trees	Trees /ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
PRWI-0025	50	707	406,000	7	23	2710	36,000	6	1	833	1
PRWI-0039	21	297	274,000	7	8	943	10,300	8	30	25,000	5
PRWI-0041	30	424	441,000	8	3	354	9080	1	-	-	-
PRWI-0097	36	509	228,000	8	10	1180	21,700	3	4	3330	2
PRWI-0120	16	226	165,000	7	9	1060	10,800	3	-	-	-
PRWI-0143	21	297	197,000	8	5	589	11,700	2	-	-	-
PRWI-0189	26	368	197,000	9	11	1300	20,500	4	5	4170	3
PRWI-0206	24	340	346,000	7	5	589	11,600	2	8	6670	4
PRWI-0227	36	509	273,000	7	12	1420	19,700	3	-	-	-
PRWI-0287	32	453	259,000	9	15	1770	34,300	4	5	4170	2
PRWI-0289	55	778	431,000	6	17	2000	26,700	4	2	1670	2
PRWI-0298	29	410	300,000	8	8	943	9480	3	5	4170	1
PRWI-0313	32	453	88,500	7	13	1530	42,700	7	20	16,700	8
PRWI-0325	31	439	316,000	5	3	354	10,200	2	3	2500	3
PRWI-0378	30	424	271,000	5	7	825	8910	3	9	7500	2
PRWI-0381	35	495	260,000	7	14	1650	25,900	3	9	7500	2
PRWI-0417	33	467	409,000	6	6	707	11,100	2	-	-	-
PRWI-0431	26	368	211,000	10	10	1180	37,600	4	9	7500	5
PRWI-0475	30	424	333,000	10	7	825	18,400	4	4	3330	3
PRWI-0512	30	424	400,000	4	10	1180	15,800	4	14	11,700	5
PRWI-0537	49	693	419,000	10	8	943	8480	4	47	39,200	1
PRWI-0546	39	552	201,000	10	16	1890	58,000	3	5	4170	3
PRWI-0575	37	523	213,000	8	5	589	18,100	2	1	833	1
PRWI-0608	33	467	248,000	10	2	236	9400	1	1	833	1
PRWI-0625	25	354	242,000	4	11	1300	33,600	3	14	11,700	6
PRWI-0651	42	594	341,000	9	5	589	17,100	2	11	9170	4
PRWI-0656	42	594	329,000	6	8	943	21,300	4	2	1670	2
PRWI-0691	30	424	229,000	9	10	1180	17,600	2	-	-	-
PRWI-0738	38	538	185,000	8	13	1530	24,700	2	10	8330	3
PRWI-0741	28	396	469,000	9	3	354	13,300	2	6	5000	2
PRWI-0742	26	368	293,000	8	13	1530	31,200	4	2	1670	2
PRWI-0744	24	340	350,000	8	7	825	19,300	3	2	1670	2
PRWI-0779	28	396	281,000	7	9	1060	23,000	3	5	4170	4
Total	1064	456	291,000	25	306	1090	20,800	18	234	5910	23

Thirty different tree species were found in Prince William (Table 72).

Table 75. Tree species found on forest monitoring plots in Prince William.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	127	14,300	13/-	26	2050	15
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	-	-	6
<i>Asimina triloba</i>	pawpaw	-	-	-	6	79	52
<i>Carpinus caroliniana</i>	American hornbeam	2	73	-	6	350	2
<i>Carya alba</i>	mockernut	17	2180	-	3	379	4
	hickory						
<i>Carya glabra</i>	pignut hickory	22	5760	-	1	18	2
<i>Carya ovalis</i>	red hickory	2	1140	-	-	-	-
<i>Castanea pumila</i>	chinkapin	-	-	-	-	-	1
<i>Cornus florida</i>	flowering dogwood	11	493	-	19	1950	-
<i>Diospyros virginiana</i>	common persimmon	1	36	-	-	-	1
<i>Fagus grandifolia</i>	American beech	153	16,000	3/-	102	5150	17
<i>Fraxinus americana</i>	white ash	2	383	-	-	-	-
<i>Ilex opaca</i>	American holly	46	2730	7/1	45	3640	35
<i>Juniperus virginiana</i>	eastern redcedar	5	637	3/-	-	-	-
<i>Liquidambar styraciflua</i>	sweetgum	11	1100	4/-	8	272	8
<i>Liriodendron tulipifera</i>	tulip poplar	104	44,400	-	1	39	1
<i>Morus rubra</i>	red mulberry	-	-	-	1	21	-
<i>Nyssa sylvatica</i>	blackgum	96	8470	3/-	59	4780	2
<i>Pinus virginiana</i>	Virginia pine	153	52,200	13/1	-	-	2
<i>Prunus serotina</i>	black cherry	1	126	-	-	-	2
<i>Quercus alba</i>	white oak	160	61,300	1/-	13	961	43
<i>Quercus coccinea</i>	scarlet oak	52	31,100	-	1	111	4
<i>Quercus falcata</i>	southern red oak	8	3930	-	4	111	3
<i>Quercus phellos</i>	willow oak	2	694	1/-	-	-	-
<i>Quercus prinus</i>	chestnut oak	52	31,300	-	1	29	24
<i>Quercus rubra</i>	northern red oak	16	6400	-	-	-	1
<i>Quercus velutina</i>	black oak	11	5800	-	2	36	3
<i>Quercus spp.</i>	oak	-	-	-	-	-	1
<i>Sassafras albidum</i>	sassafras	9	541	1/-	8	872	6
<i>Ulmus americana</i>	American elm	1	80	-	-	-	-

Shrubs were scattered in Prince William (Table 73).

Table 76. Density, basal area, seedling density and species richness of shrubs in Prince William.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
PRWI-0025	-	-	-	-	-	-
PRWI-0039	-	-	-	-	-	-
PRWI-0041	-	-	-	-	-	-
PRWI-0097	2	236	1	6900	-	-
PRWI-0120	7	825	3	212,000	-	-
PRWI-0143	1	118	1	31,000	-	-
PRWI-0189	5	589	1	8850	-	-
PRWI-0206	-	-	-	-	-	-
PRWI-0227	-	-	-	-	-	-
PRWI-0287	-	-	-	-	3	2500
PRWI-0289	1	118	1	943	-	-
PRWI-0298	-	-	-	-	2	1670
PRWI-0313	7	825	2	62,200	2	1670
PRWI-0325	51	6010	2	519,000	19	15,800
PRWI-0378	-	-	-	-	-	-
PRWI-0381	-	-	-	-	-	-
PRWI-0417	4	472	1	3480	3	2500
PRWI-0431	12	1420	3	14,300	8	6670
PRWI-0475	-	-	-	-	-	-
PRWI-0512	23	2710	1	44,200	1	833
PRWI-0537	-	-	-	-	-	-
PRWI-0546	1	118	1	10,200	-	-
PRWI-0575	-	-	-	-	-	-
PRWI-0608	-	-	-	-	-	-
PRWI-0625	35	4130	2	79,600	11	9170
PRWI-0651	1	118	1	130	-	-
PRWI-0656	24	2830	1	20,000	16	13,300
PRWI-0691	-	-	-	-	-	-
PRWI-0738	-	-	-	-	-	-
PRWI-0741	-	-	-	-	-	-
PRWI-0742	2	236	1	2540	-	-
PRWI-0744	-	-	-	-	-	-
PRWI-0779	-	-	-	-	-	-
Total	176	629	7	30,800	65	1640

Seven species of shrubs were found in the microplots (Table 74).

Table 77. Shrub species found in Prince William.

Latin Name	Common Name	Shrubs	Seedlings
<i>Euonymus americana</i>	bursting-heart	-	2
<i>Hamamelis virginiana</i>	American witchhazel	2	-
<i>Kalmia latifolia</i>	mountain laurel	157	49
<i>Lyonia ligustrina</i>	maleberry	-	12
<i>Rhododendron periclymenoides</i>	pink azalea	-	2
<i>Vaccinium corymbosum</i>	highbush blueberry	11	-
<i>Vaccinium fuscatum</i>	black highbush blueberry	6	-

Forest Pests and Diseases

No targeted forest pests or diseases were found in Prince William.

Exotic Plant Species

Exotic Trees

No exotic trees were found in Prince William.

Vines on Trees

Relatively few trees have vines growing on them (Table 75).

Table 78. Presence of vines in Prince William.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
PRWI-0025	50	12	1
PRWI-0039	21	-	-
PRWI-0041	30	-	-
PRWI-0097	36	8	-
PRWI-0120	16	4	-
PRWI-0143	21	-	-
PRWI-0189	26	-	-
PRWI-0206	24	-	-
PRWI-0227	36	-	-
PRWI-0287	32	-	-
PRWI-0289	55	-	-
PRWI-0298	29	-	-
PRWI-0313	32	3	-
PRWI-0325	31	-	-
PRWI-0378	30	15	1
PRWI-0381	35	-	-
PRWI-0417	33	-	-
PRWI-0431	26	6	-
PRWI-0475	30	-	-
PRWI-0512	30	-	-
PRWI-0537	49	-	-
PRWI-0546	39	-	-
PRWI-0575	37	-	-
PRWI-0608	33	-	-
PRWI-0625	25	-	-
PRWI-0651	42	-	-
PRWI-0656	42	1	-
PRWI-0691	30	-	-
PRWI-0738	38	-	-
PRWI-0741	28	-	-
PRWI-0742	26	-	-
PRWI-0744	24	-	-
PRWI-0779	28	-	-
Total	1064	49	2

Most of the vines that are growing on trees are *Smilax* species (Table 76).

Table 79. Species of vines in trees in Prince William.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	5	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	4	-
<i>Smilax</i> spp.	greenbrier	44	2
<i>Vitis</i> spp.	grape	4	1

¹Non-native species.

Exotic Shrubs

No exotic shrubs were found on the Prince William plots

Exotic Herbaceous Plants

Few of the plots at Prince William had exotic herbaceous plants present (Table 77).

Table 80. Presence of exotic herbaceous plants in Prince William.

Plot	Quadrats with Exotics	Number of Exotic Species
PRWI-0025	-	-
PRWI-0039	-	-
PRWI-0041	-	-
PRWI-0097	-	-
PRWI-0120	-	-
PRWI-0143	-	-
PRWI-0189	-	-
PRWI-0206	2	2
PRWI-0227	-	-
PRWI-0287	-	-
PRWI-0289	-	-
PRWI-0298	-	-
PRWI-0313	-	-
PRWI-0325	-	-
PRWI-0378	10	3
PRWI-0381	-	-
PRWI-0417	-	-
PRWI-0431	-	-
PRWI-0475	1	1
PRWI-0512	-	-
PRWI-0537	1	1
PRWI-0546	-	-
PRWI-0575	-	-
PRWI-0608	-	-
PRWI-0625	-	-
PRWI-0651	-	-
PRWI-0656	-	-
PRWI-0691	-	-
PRWI-0738	-	-
PRWI-0741	-	-
PRWI-0742	-	-
PRWI-0744	-	-
PRWI-0779	2	1
Total	16	4

Only four species were found (Table 78) none of which had a high percent cover.

Table 81. Cover of exotic plants in Prince William.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	1	<1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	3	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3	3%

Rock Creek Park

Two forest plots were monitored in Rock Creek in 2006 (Figure 10).



Figure 10. Locations considered for monitoring in Rock Creek.

Forest Communities

Information on tree density and basal area is reported in Table 79. Fourteen tree species were found in Rock Creek (Table 80).

Table 82. Density, basal area (BA) and richness of trees saplings and seedlings in Rock Creek.

Plot	Trees	Trees /ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
ROCR-0172	18	255	535,000	1	1	118	1330	1	3	2500	2
ROCR-0186	25	354	353,000	9	10	1180	19,000	5	-	-	-
Total	43	304	444,000	10	11	648	10,200	6	3	1250	2

Table 83. Tree species found in Rock Creek.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/ in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	7	13,900	6/1	4	5010	-
¹ <i>Acer platanoides</i>	Norway maple	1	2050	1/-	3	3060	-
<i>Acer rubrum</i>	red maple	-	-	-	1	648	-
<i>Fagus grandifolia</i>	American beech	-	-	-	-	-	2
<i>Fraxinus americana</i>	white ash	3	4320	3/-	-	-	-
<i>Juglans nigra</i>	black walnut	3	49,300	3/-	-	-	-
<i>Liriodendron tulipifera</i>	tulip poplar	18	268,000	14/-	-	-	-
¹ <i>Malus sieboldii</i>	toringa crabapple	1	580	-	1	118	-
<i>Populus deltoides</i>	eastern cottonwood	2	36,500	2/1	-	-	-
<i>Prunus serotina</i>	black cherry	-	-	-	-	-	1
<i>Quercus palustris</i>	pin oak	1	10,900	1/-	-	-	-
¹ <i>Sophora japonica</i>	Japanese pagoda tree	-	-	-	1	1000	-
<i>Tsuga canadensis</i>	eastern hemlock	2	43,500	1/-	-	-	-
<i>Ulmus americana</i>	American elm	5	15,100	2/-	1	295	-

¹Non-native species.

Both monitoring plots had numerous shrubs (Table 81).

Table 84. Density, basal area, seedling density and species richness of shrubs in Rock Creek.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
ROCR-0172	35	4130	2	261,000	15	12,500
ROCR-0186	24	2830	2	47,900	3	2500
Total	59	3480	4	155,000	18	7500

Four shrub species were found (Table 82).

Table 85. Shrubs found in Rock Creek.

Latin Name	Common Name	Shrubs	Seedlings
<i>Lindera benzoin</i>	northern spicebush	33	15
¹ <i>Lonicera maackii</i>	Amur honeysuckle	-	2
¹ <i>Viburnum plicatum</i>	Japanese snowball	3	1
¹ <i>Viburnum sieboldii</i>	Siebold's arrowwood	23	-

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found in Rock Creek.

Exotic Plant Species

Exotic Trees

Three exotic tree species (Table 80) were found on ROCR-0186 along Rock Creek Parkway. They make up 4.7% of all individuals and 4.2% of all basal area in the tree layer, 45.5% of all individuals and 41.1% of all basal area in the sapling layer, but are absent from the seedling layer.

Vines in Trees

Most trees had vines growing on them, though in few cases did they reach the tree crowns (Table 83).

Table 86. Presence of vines in Rock Creek.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
ROCR-0172	18	14	-
ROCR-0186	25	19	2
Total	43	33	2

Most of the vines found in Rock Creek are exotic (Table 84).

Table 87. Species of vines in trees in Rock Creek.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	Amur peppervine	1	-
¹ <i>Euonymus fortunei</i>	winter creeper	1	-
¹ <i>Hedera helix</i>	English ivy	29	1
<i>Toxicodendron radicans</i>	eastern poison ivy	11	-
<i>Vitis</i> spp.	grape	6	2

¹Non-native species.

Exotic Shrubs

Three species of exotic shrubs were found on the two plots (Table 82). These make up 44.1% of all shrubs found on the Rock Creek plots.

Exotic Herbaceous Plants

Both plots in Rock Creek had exotic herbaceous species (Table 85).

Table 88. Presence of exotic herbaceous plants in Rock Creek.

Plot	Quadrats with Exotics	Number of Exotic Species
ROCR-0172	12	8
ROCR-0186	12	2
Total	24	8

Eight exotic herbaceous species were present, of which English ivy (*Hedera helix*) had the highest percent cover (Table 86).

Table 89. Cover of herbaceous exotic plants in Rock Creek.

Latin name	Common name	Plots	Mean % cover on all quadrats when present in plot
<i>Alliaria petiolata</i>	garlic mustard	2	1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	6%
<i>Duchesnea indica</i>	Indian strawberry	1	3%
<i>Euonymus fortunei</i>	winter creeper	1	<1%
<i>Hedera helix</i>	English ivy	2	48%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	<1%
<i>Rosa multiflora</i>	multiflora rose	1	<1%
<i>Rubus phoenicolasius</i>	wine raspberry	1	<1%

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Appendix A. Forest Pests and Diseases Targeted for Monitoring in 2007.

Pest or Disease	Scientific Name	Year Monitoring Began
Beech bark disease	<i>Nectria</i> spp.	2006
Butternut canker	<i>Sirococcus clavigignenti-juglandacearum</i>	2006
Gypsy moth	<i>Lymantria dispar</i>	2006
Hemlock wooly adelgid	<i>Adelges tsugae</i>	2006
Spruce budworm	<i>Choristoneura</i> spp.	2006
Other significant insect damage		2006

Appendix B. Woody Plants Monitored as Shrubs in 2007.

Latin Name	Common Name	Year added
<i>Clethra</i> spp.	sweet pepper bush	2006
<i>Elaeagnus umbellata</i>	autumn olive	2006
<i>Euonymus alatus</i>	winged burning bush	2006
<i>Euonymus americana</i>	bursting-heart	2007
<i>Euonymus atropurpureus</i>	burning bush	2007
<i>Gaylussacia frondosa</i>	blue huckleberry	2007
<i>Hamamelis virginiana</i>	American witch-hazel	2006
<i>Ilex verticillata</i>	common winterberry	2006
<i>Kalmia latifolia</i>	mountain laurel	2006
<i>Ligustrum obtusifolia</i>	border privet	2006
<i>Lindera benzoin</i>	northern spicebush	2006
<i>Lonicera mackii</i>	amur honeysuckle	2006
<i>Lyonia ligustrina</i>	maleberry	2007
<i>Rhododendron periclymenoides</i>	pink azalea	2007
<i>Rhus</i> spp.	sumac	2006
<i>Rubus argutus</i>	sawtooth blackberry	2007
<i>Sambucus pubens</i>	red elderberry	2007
<i>Staphylea trifolia</i>	American bladdernut	2006
<i>Symphoricarpos orbiculatus</i>	coralberry	2006
<i>Vaccinium corymbosum</i>	highbush blueberry	2006
<i>Vaccinium fuscum</i>	black highbush blueberry	2007
<i>Vaccinium stamineum</i>	deerberry	2006
<i>Viburnum acerifolium</i>	mapleleaf viburnum	2006
<i>Viburnum dentatum</i>	southern arrowwood	2006
<i>Viburnum plicatum</i>	Japanese snowball	2007
<i>Viburnum prunifolium</i>	blackhaw	2007
<i>Viburnum sieboldii</i>	Siebold's arrowwood	2007

Appendix C. Exotic Invasive Understory Plants Monitored in 2007.

Latin Name	Common Name	Year Added
<i>Akebia quinata</i>	chocolate vine	2006
<i>Alliaria petiolata</i>	garlic mustard	2006
<i>Ampelopsis brevipedunculata</i>	porcelain berry	2006
<i>Berberis thunbergii</i>	Japanese barberry	2006
<i>Celastrus orbiculatus</i>	oriental bittersweet	2006
<i>Centaurea biebersteinii</i>	spotted knapweed	2006
<i>Cirsium arvense</i>	Canada thistle	2006
<i>Clematis terniflora</i>	sweet autumn	2006
<i>Duchesnea indica</i>	India mock strawberry	2006
<i>Euonymus fortunei</i>	winter creeper	2006
<i>Glechoma hederacea</i>	ground ivy	2006
<i>Hedera helix</i>	English ivy	2006
<i>Heimerocallis fulva</i>	orange day lily	2006
<i>Lespedeza cuneata</i>	Chinese lespedeza	2006
<i>Lonicera japonica</i>	Japanese honeysuckle	2006
<i>Lonicera</i> spp.	honeysuckle	2006
<i>Microstegium vimineum</i>	Japanese stiltgrass	2006
<i>Polygonum cuspidatum</i>	Japanese knotweed	2006
<i>Polygonum perfoliatum</i>	mile-a-minute	2006
<i>Pueraria montana</i>	kudzu	2006
<i>Ranunculus ficaria</i>	fig buttercup	2006
<i>Rosa multiflora</i>	multiflora rose	2006
<i>Rubus phoenicolasius</i>	wineberry	2006
<i>Viburnum dilatatum</i>	Linden arrowwood	2006
<i>Vinca minor</i>	common periwinkle	2006
<i>Wisteria sinensis</i>	Chinese wisteria	2006

Appendix D. Updated List of Trees Monitored in 2006.

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	199	10,000	296	3750	86
<i>Acer nigrum</i>	black maple	1	204	-	-	-
¹ <i>Acer platanoides</i>	Norway maple	1	24	1	1	-
<i>Acer rubrum</i>	red maple	183	8620	43	960	26
<i>Acer saccharinum</i>	silver maple	51	15,900	1	59	13
<i>Acer saccharum</i>	sugar maple	19	1420	6	325	-
¹ <i>Ailanthus altissima</i>	tree of heaven	28	2820	4	9	25
<i>Amelanchier arborea</i>	common serviceberry	5	82	4	110	6
<i>Asimina triloba</i>	pawpaw	8	124	146	1370	124
<i>Betula alleghaniensis</i>	yellow birch	4	187	-	-	-
<i>Betula lenta</i>	sweet birch	13	743	2	47	1
<i>Carpinus caroliniana</i>	American hornbeam	13	185	21	582	7
<i>Carya alba</i>	mockernut hickory	86	4990	8	66	20
<i>Carya cordiformis</i>	bitternut hickory	18	1610	1	2	7
<i>Carya glabra</i>	pignut hickory	86	6110	16	589	13
<i>Carya ovalis</i>	red hickory	1	23	-	-	-
<i>Castanea pumila</i>	chinkapin	-	-	3	15	-
<i>Celtis occidentalis</i>	common hackberry	35	2420	-	-	4
<i>Cercis canadensis</i>	eastern redbud	1	12	2	121	23
<i>Cornus florida</i>	flowering dogwood	11	177	32	884	2
<i>Diospyros virginiana</i>	common persimmon	5	287	16	44	3
<i>Fagus grandifolia</i>	American beech	204	10,400	139	2300	6
<i>Fraxinus americana</i>	white ash	54	3680	11	209	29
<i>Fraxinus nigra</i>	black ash	1	123	-	-	50
<i>Fraxinus pennsylvanica</i>	green ash	12	2190	4	141	-
<i>Gleditsia triacanthos</i>	honey locust	-	-	-	-	47
<i>Ilex opaca</i>	American holly	25	499	52	737	1
<i>Juglans nigra</i>	black walnut	24	3670	1	17	50
<i>Juniperus virginiana</i>	eastern red cedar	119	4020	26	1010	-
<i>Liquidambar styraciflua</i>	sweetgum	56	3610	12	140	1
<i>Liriodendron tulipifera</i>	tuliptree	226	40,700	3	184	57
¹ <i>Maclura pomifera</i>	Osage orange	27	1550	2	91	10
<i>Magnolia acuminata</i>	cucumber-tree	2	386	-	-	-
¹ <i>Malus baccata</i>	Siberian crabapple	-	-	1	20	-
¹ <i>Morus alba</i>	white mulberry	5	578	-	-	-
<i>Morus rubra</i>	red mulberry	1	17	1	20	1
<i>Nyssa sylvatica</i>	blackgum	144	5600	85	2310	-
<i>Ostrya virginiana</i>	hophornbeam	4	130	-	-	13
<i>Pinus echinata</i>	shortleaf pine	1	86	-	-	1
<i>Pinus rigida</i>	pitch pine	1	116	-	-	-
<i>Pinus virginiana</i>	Virginia pine	279	28,300	-	-	-
<i>Platanus occidentalis</i>	American sycamore	32	7750	2	99	4
<i>Populus deltoides</i>	eastern cottonwood	1	419	-	-	-

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Populus grandidentata</i>	bigtooth aspen	1	149	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	5	151	2	92	-
<i>Prunus serotina</i>	black cherry	37	4080	6	104	28
<i>Quercus alba</i>	white oak	172	24,900	45	604	172
<i>Quercus bicolor</i>	swamp white oak	1	272	-	-	-
<i>Quercus coccinea</i>	scarlet oak	68	9670	5	13	21
<i>Quercus falcata</i>	southern red oak	17	2750	6	133	1
<i>Quercus muehlenbergii</i>	chinkapin oak	2	39	-	-	-
<i>Quercus palustris</i>	pin oak	14	1570	1	12	-
<i>Quercus phellos</i>	willow oak	2	1030	-	-	-
<i>Quercus prinus</i>	chestnut oak	110	14,200	7	164	1
<i>Quercus rubra</i>	northern red oak	69	13,600	3	111	12
<i>Quercus stellata</i>	post oak	16	2190	6	127	-
<i>Quercus velutina</i>	black oak	34	5310	2	139	-
<i>Quercus X bushii</i>	oak	1	81	-	-	-
<i>Quercus X fernowii</i>	oak	1	165	-	-	-
<i>Robinia pseudoacacia</i>	black locust	21	1150	-	-	1
<i>Sassafras albidum</i>	sassafras	5	118	12	408	33
<i>Tilia americana</i>	American basswood	3	379	1	1	-
<i>Tsuga canadensis</i>	eastern hemlock	23	1170	11	133	-
<i>Ulmus americana</i>	American elm	63	2970	13	302	7
¹ <i>Ulmus pumila</i>	Siberian elm	10	1210	1	53	-
<i>Ulmus rubra</i>	slippery elm	7	643	1	39	3

¹Non-native species.

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